



**Potential natural vegetation of eastern Africa (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). Volume 10**

**Atlas and Tree Species Composition for Tanzania.**

Lillesø, Jens-Peter Barnekow; van Breugel, Paulo; Kindt, R.; Mbago, F.; Moshi, H.N.; Ndangalasi, H.J.; Uronu, L.O.N.; Jamnadass, R.; Graudal, Lars

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IGN Report

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# Introduction

This book represents **Volume 10** in a eleven-volume series that documents the potential natural vegetation map that was developed by the VECEA (Vegetation and Climate change in East Africa) project. The VECEA map was developed as a collaborative effort that included partners from each of the seven VECEA countries (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia).

- In **Volume 1**, we present the potential natural vegetation map that we developed for seven countries in eastern Africa. In Volume 1, we also introduce the concept of potential natural vegetation and give an overview of different application domains of the VECEA map.
- **Volumes 2 to 5** describe potential natural vegetation types, also including lists of the “useful tree species” that are expected to naturally occur in each vegetation type – and therefore also expected to be adapted to the environmental conditions where the vegetation types are depicted to occur on the map. **Volume 2** focuses on forest and scrub forest vegetation types. **Volume 3** focuses on woodland and wooded grassland vegetation types. **Volume 4** focuses on bushland and thicket vegetation types. In **Volume 5**, information is given for vegetation types that did not feature in Volumes 2 to 4.
- **Volume 6** gives details about the process that we followed in making the VECEA map.
- **Volume 7** shows the results of modelling the distribution of potential natural vegetation types for six potential future climates.
- **Volumes 8 to 11** provide a national atlas for four of the seven VECEA countries (Kenya, Rwanda, Tanzania and Uganda). We also provide a summary of the descriptions and species composition of potential natural vegetation types that occur in the species country.

We strongly encourage users of the VECEA map to get familiarized with all volumes. For example, as Volume 6 provides a detailed account of the process that we followed in creating the VECEA map, we have not repeated these details in the volumes that provide the national atlases.

**Erratum (May 18, 2020):** Authorships, localities and dates of photographs have been corrected in the figure captions for 9 different photos in volumes 2, 4, 5, 8, 9, 10, and 11.

Volume 2 Forest	Figures 6.1; 6.2; 20.1
Volume 4 Bushland	Figures 4.7; 7.4; 7.5; 7.8
Volume 5 Other	Figures 3.5; 4.2; 5.4
Volume 8 Kenya	Figures 8.1; 8.2; 16.1; 25.7; 26.4; 26.5; 26.6; 28.5; 29.2; 30.4
Volume 9 Rwanda	Figures 7.1; 7.2; 10.1; 14.7; 15.4; 15.5; 15.6; 16.5; 17.2
Volume 10 Tanzania	Figures 8.1; 8.2; 16.1, 26.7, 27.4; 27.5; 27.6; 30.5; 31.2
Volume 11 Uganda	Figures 8.1; 8.2; 11.1; 20.7; 21.4; 21.5; 21.6; 22.5; 23.2

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Thanks to UNEP-GEF for funding the Carbon Benefits Project (CBP) through which information was compiled on indicator and characteristic species for The Vegetation Map of Africa (White 1983). (This work led to the publication in 2011 of an Africa-wide tree species selection tool that is available from: [http://www.worldagroforestrycentre.org/our\\_products/databases/useful-tree-species-africa](http://www.worldagroforestrycentre.org/our_products/databases/useful-tree-species-africa)) Thanks to BMZ for funding the ReACCT project in Tanzania through which funding was made available for field verification of the VECEA map around Morogoro (this was essential in preparing the VECEA map as the base map for Tanzania was essentially a physiognomic map.

We are grateful for the assistance provided by Meshack Nyabenge (ICRAF) and Jane Wanjara (ICRAF) for digitization of maps.

# Abbreviations

Abbreviation	Full
A	Afroalpine vegetation
B	Afromontane bamboo
Bd	Somalia-Masai <i>Acacia-Commiphora</i> deciduous bushland and thicket
Be	Evergreen and semi-evergreen bushland and thicket
bi (no capital)	Itigi thicket (edaphic vegetation type)
br (no capital)	Riverine thicket (edaphic vegetation type, mapped together with riverine forest and woodland)
C	In species composition tables: we have information that this species is a characteristic (typical) species in a national manifestation of the vegetation type
D	Desert
DBH	diameter at breast height (1.3 m)
E	Montane <i>Ericaceous</i> belt (easily identifiable type)
f (no capital)	In species composition tables: since this species is present in the focal country and since it was documented to occur in the same vegetation type in some other VECEA countries, this species potentially occurs in the national manifestation of the vegetation type
Fa	Afromontane rain forest
Fb	Afromontane undifferentiated forest (Fbu) mapped together with Afromontane single-dominant <i>Juniperus procera</i> forest (Fbj)
Fc	Afromontane single-dominant <i>Widdringtonia whytei</i> forest
fc (no capital)	Zanzibar-Inhambane scrub forest on coral rag (fc, edaphic forest type)
Fd	Afromontane single-dominant <i>Hagenia abyssinica</i> forest
Fe	Afromontane moist transitional forest
fe (no capital)	Lake Victoria <i>Euphorbia dawei</i> scrub forest (fe, edaphic forest type mapped together with evergreen and semi-evergreen bushland and thicket)
FeE	distinct subtype of Afromontane moist transitional forest in Ethiopia
FeK	distinct subtype of Afromontane moist transitional forest in Kenya
Ff	Lake Victoria transitional rain forest
Fg	Zanzibar-Inhambane transitional rain forest
Fh	Afromontane dry transitional forest
Fi	Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest
FLD	Forest & Landscape (URL <a href="http://sl.life.ku.dk/English.aspx">http://sl.life.ku.dk/English.aspx</a> )
Fm	Zambezian dry evergreen forest
Fn	Zambezian dry deciduous forest and scrub forest
Fo	Zanzibar-Inhambane lowland rain forest
Fp	Zanzibar-Inhambane undifferentiated forest
Fq	Zanzibar-Inhambane scrub forest
fr (no capital)	Riverine forests (fr, edaphic forest type mapped together with riverine woodland and thicket)
Fs	Somalia-Masai scrub forest (Fs, mapped together with evergreen and semi-evergreen bushland and thicket)
fs (no capital)	Swamp forest (fs, edaphic forest type)
G	Grassland (excluding semi-desert grassland and edaphic grassland, G)
g (no capital)	Edaphic grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type, g)
GCM	General Circulation Models
GHG	greenhouse gas
gv	Edaphic grassland on volcanic soils (edaphic subtype, gv)
ICRAF	World Agroforestry Centre (URL <a href="http://www.worldagroforestry.org/">http://www.worldagroforestry.org/</a> )
IPCC	Intergovernmental Panel on Climate Change
L	Lowland bamboo
M	Mangrove

P	Palm wooded grassland (physiognomically easily recognized type)
PROTA	Plant Resources of Tropical Africa (URL <a href="http://www.prota.org/">http://www.prota.org/</a> )
S	Somalia-Masai semi-desert grassland and shrubland
PNV	Potential Natural Vegetation
s (no capital)	Vegetation of sands (edaphic type)
SRES	Special Report on Emissions Scenarios
T	<i>Termitaria</i> vegetation (easily identifiable and edaphic type, including bush groups around <i>termitaria</i> within grassy drainage zones)
UNEP	United Nations Environment Programme (URL <a href="http://www.unep.org/">http://www.unep.org/</a> )
VECEA	Vegetation and Climate Change in Eastern Africa project (funded by the Rockefeller Foundation)
Wb	<i>Vitellaria</i> wooded grassland
Wc	<i>Combretum</i> wooded grassland
Wcd	dry <i>Combretum</i> wooded grassland subtype
Wcm	moist <i>Combretum</i> wooded grassland subtype
WCMC	World Conservation Monitoring Centre (URL <a href="http://www.unep-wcmc.org/">http://www.unep-wcmc.org/</a> )
wd (no capital)	Edaphic wooded grassland on drainage-impered or seasonally flooded soils (edaphic vegetation type)
We	Biotic <i>Acacia</i> wooded grassland
Wk	Kalahari woodland
Wm	Miombo woodland
Wmd	Drier miombo woodland subtype
Wmr	Miombo on hills and rocky outcrops subtype
Wmw	Wetter miombo woodland subtype
Wn	north Zambezian undifferentiated woodland and wooded grassland (abbreviation: undifferentiated woodland)
Wo	Mopane woodland and scrub woodland
wr (no capital)	Riverine woodland (edaphic vegetation type, mapped together with riverine forest and thicket)
Wt	<i>Terminalia sericea</i> woodland
Wvs	<i>Vitex</i> - <i>Phyllanthus</i> - <i>Shikariopsis</i> ( <i>Sapium</i> ) - <i>Terminalia</i> woodland (not described regionally)
Wvt	<i>Terminalia glaucescens</i> woodland (not described regionally)
Wy	Chipya woodland and wooded grassland
X	Fresh-water swamp
x (no capital)	In species composition tables: we have information that this species is present in a national manifestation of the vegetation type
Z	Halophytic vegetation
ZI	Zanzibar-Inhambane coastal mosaic (Kenya and Tanzania coast)

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# 1. The rationale of the VECEA map

The VECEA map of eastern and southern Africa (Ethiopia, Kenya, Uganda, Rwanda, Tanzania, and Zambia) is the product of a project funded by The Rockefeller Foundation and implemented by Forest and Landscape Denmark, World Agroforestry Centre, Nairobi, and botanical experts in the seven countries. The project also benefited from previous support to botanists at the relevant departments at the universities of Makerere/Dar es Salaam by an ENRECA programme provided by Danida and previous support to Ethiopian Flora Project provided by SIDA/SAREC and through grants from the Carlsberg Foundation.

The documentation of the VECEA vegetation map consists of seven volumes. In this volume 1, we present the map, and we briefly discuss the important concepts utilised and applied in the map. In volumes 2 to 5, we provide a detailed documentation and discussion of the five major physiognomic vegetation categories and their variation in vegetation types as well as distribution of tree species in this framework. In volume 6, we describe the original maps that we have utilised for each country and we document and discuss the modelling procedures and processes. In volume 7, we model how vegetation types may develop under different climate change scenarios.

So why did we chose to make a regional vegetation map when similar maps have already been developed (Olson *et al.*, 2001; Whittaker *et al.*, 2005)? The most recent is the ecoregional approach developed by World Wildlife Fund (WWF), Nature Conservancy, and Conservation International. In WWF's terrestrial ecoregion scheme<sup>(1)</sup>, White's vegetation map (and memoir) of Africa (White, 1983) - henceforth called the White map - serve as the basis for the ecoregions of the Afrotropics (Olson *et al.*, 2001; Burgess *et al.* 2004). In this process the ecoregions map has mainly become a simplified version of the White map. A major objective of the White map is to provide a framework on a continental scale within which more detailed local studies can be conducted and compared and as such the map is suitable as a basis for describing the terrestrial ecoregions of Africa by capturing the broad-scale patterns of biological diversity and the ecological processes that sustain them.

We have taken the opposite approach of WWF's terrestrial ecoregion scheme by deconstructing<sup>(2)</sup> the White map into its more detailed parts. We have done this by utilising the same smaller maps as those that White utilised and to a large extent described in his text without directly mapping them. The VECEA map thus differs in terms of the spatial resolution, which allows us to break down the landscape into more well defined mapping units.

1: See also <http://www.worldwildlife.org/science/ecoregions/ecoregion-conservation.html>

2: Our method can best be described by paraphrasing the term deconstruction (Derrida, 1967). The White map is an interpretation of reality and we explain it and provide a higher resolution map by revisiting the maps and botanical research that he used to make his map. The VECEA map is thus also an interpretation of reality, but at a higher resolution.

So why do we think that a higher resolution of the map is important? It is in the nature of the scale of the White map (1:5,000,000) that vegetation units on the map are heterogeneous in character and only broadly delineated and thus it is not possible to utilise the White map for a more detailed understanding of vegetation dynamics and species distributions, which is an understanding that is required if a map should be of importance for field

implementation (see below for the intended uses of the VECEA map). Furthermore for practically all indigenous species in the region there is insufficient point location data available to make good estimates of their actual and potential distributions across landscapes. A higher resolution of maps and consequently more detailed predictions of species distribution, however, opens up a new discussion of how to interpret vegetation dynamics at the community level (see below for our discussion of Potential Natural Vegetation), but this discussion is unavoidable and necessary for successful field implementation. The great advantage of mapping at a higher resolution is that the interpretation of community dynamics becomes publicly available and can be disputed and tested. This is in contrast to ecoregion maps where managers of restoration projects and tree planters must make their own guesses based on very generalised recommendations.

In comparison with White, we have had the advantage of computer based technologies that has enabled us to provide a higher resolution for a very large geographic area. Based on our analysis, we are in overall agreement with White's methodology and approach and we will provide a detailed discussion of the VECEA map in a number of peer reviewed papers. The process of elaborating the regional map has been iterative. Almost all available relevant vegetation information for the VECEA countries from early 20th century and onwards were collated and digitised. The botanists prepared national maps based on their interpretation of available vegetation maps and botanical information. The preparation of the regional map was a process of harmonisation of nomenclature and interpretation of vegetation types in an interaction between the team members.

The main objective for preparing the map is utilitarian and closely related to the requirement for a more detailed understanding of the indigenous tree species in the region – to improve the productivity of smallholder tree growers utilising the species in agroforestry systems. The utility of the map, however, goes beyond understanding the productivity of indigenous tree species and encompasses a more general understanding of agricultural productivity and conservation of fauna and flora in ecosystems.

In summary, the utility of the VECEA vegetation map, complemented with additional information on vegetation development and other environmental data layers, is that it:

- (i) provides an integrated interpretation of landscapes and indicates the position of transitions between areas with significantly different environmental conditions, conditions which are most likely to be important determinative factors for agricultural potential;
- (ii) predicts potential distributions of indigenous plant species in the agricultural landscapes and predicts possible genetic variation across distributional ranges;
- (iii) can be a tool for predicting potential distributions of species of terrestrial animals, birds, reptiles, and invertebrates in remaining natural vegetation;
- (iii) can be a user friendly extension tool for improving the potential

options (both from indigenous and exotic species) available to farmers in their quest for improving livelihoods and income generation;

- (iv) provides for possible forecasts of changes in agricultural potential resulting from climate change;
- (v) provides a management tool for interpretation of historical, current, and future distribution of ecosystems and ecoregions, including alternative stable states;
- (vi) provides a tool for ecological restoration and protection of ecosystems.

## 2. Definition of forest, woodland, wooded grassland, bushland and thicket

**Forests** are continuous stands of trees at least 10 m tall with interlocking crowns (White 1983 p. 46). White (1983 p. 46) distinguishes **scrub forests** that are intermediate in structure between forest and bushland (and thicket). They are usually 10 - 15 m high. Trees (woody plants with well-defined and upright boles) are usually present but do not form a closed canopy. Smaller woody plants (principally bushes and shrubs) contribute at least as much as the trees to the appearance of the vegetation and its phytomass.

**Woodlands** are open stands of trees of at least 8 m tall with a canopy cover of 40 percent or more(1), but never with interlocking crowns and usually with a field layer of heliophilous ('sun-loving') grasses. Woodlands have similar height as **forests**, but woodlands never have densely interlocking crowns (although the crowns can be in contact). White (1983 p. 46) distinguishes **scrub woodlands** that are intermediate in structure between woodland and bushland, being stunted variants (< 8 m) of main woodland vegetation types (i.e. containing the same dominant tree species).

**Bushlands** are open stands of bushes (usually between 3 and 7 m tall) with a canopy cover of 40 percent or more. **Thickets** are closed stands of bushes (usually between 3 and 7 m tall) where the bushes are so densely interlaced that they are impenetrable - except along tracks made by animals. Bushlands and thickets are taller than **shrublands** defined as open or closed stands of shrubs up to 2 m tall (White 1983 p. 46).

**Wooded grasslands** are lands covered with grasses and other herbs with woody plants (trees [ $\geq 7$  m tall], bushes [3 - 7 m], dwarf trees, palm trees or shrubs [ $\leq 2$  m]) covering between 10 and 40 percent of the ground. Woody plants nearly always occur scattered (White 1983 pp. 46, 47 and 52).

**Grasslands** are defined as lands covered with grasses and other herbs and where woody plants do not cover more than 10% of the ground (White 1983 p. 46).

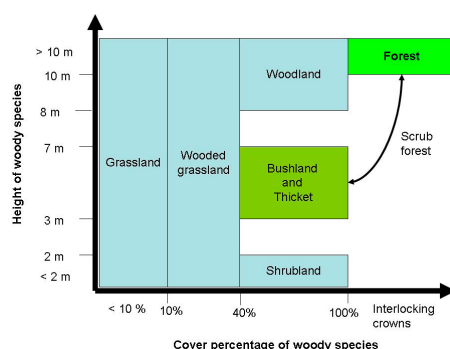


Figure 1. Height and cover percentage limits for major physiognomic types. Scrub forest is defined as a physiognomic mosaic of forest and bushland and thicket

### 3. What is potential natural vegetation?

We will here attempt to clarify how we interpret and implement terms utilised in the classification of vegetation. The central concept “Potential Natural Vegetation” in the VECEA map can be seen as the pivot around which a whole range of contested assumptions circle. These unavoidable assumptions are concerned with the distribution and dynamics of species and vegetation. While it is indisputable that plants are not randomly distributed geographically and in time, there is an ongoing debate about at what scale patterns can be discerned and whether plant species form assemblies that follow similar distribution patterns.

Friis (1998) in his review of the development of chorology explains that one of the earliest disputes in botany was about classifying plant distributions (plant chorology). In the beginning of the 19th century J.F. Schouw divided the globe into areas with more or less defined floras. Some of the most important criteria were based on presence or absence of characteristic species and without making assumptions about the historical development of the flora. Some twenty years later in a large work on plant geography A. de Candolle completely rejected a natural classification of the world into phytochoria because. (i) the plant world was too poorly known, and (ii) scientists did not apply sufficiently logical criteria. During the following century many scholars further contributed to the understanding of plant chorology in Africa and there is now a general consensus on chorology as a useful tool to describe plant species distributions in Africa - contrary to the situation in Europe (Friis, 1998). Frank White has been a major contributor and chorological patterns are an important integral part of White's vegetation map. Although logical, the criteria utilised are still not completely objective in the strictest sense. As Friis points out, White more than once stated that “there is no *a priori* reasons why the pattern lines on a vegetation map based on physiognomy of vegetation should coincide closely with those of a chorological map based on the coinciding distributional limits of species.” But the results of his work with the vegetation map of Africa showed that if the chorological map of Africa was based on chorological data alone, rather than on transferring pattern lines from a detailed vegetation map, the pattern lines would not have been significantly different” (Friis, 1998 p. 37).

Early concepts concerned with the definition of community patterns in space are the biome<sup>(3)</sup>, that was introduced to plant ecology by Clements in the first half of the 20th century and ecoregion that was introduced by Crowley, and Bailey in the second half of the same century (see discussion in Pennington *et al.*, 2004). The concepts are largely overlapping and assume that one can discern broad scale patterns in the distribution of ecological communities, which are defined by similar climax plant formations and environmental conditions. A major difference is that an ecoregion is never discontinuous, while a biome is in principle always coincident with the climax vegetation and therefore can consist of disjunct areas (Bailey, 2005). Biomes

3: Biome, also called major life zone, the largest geographic biotic unit, a major community of plants and animals with similar life forms and environmental conditions. It includes various communities and is named for the dominant type of vegetation, such as grassland or coniferous forest. Several similar biomes constitute a biome type - for example, the temperate deciduous forest biome type includes the deciduous forest biomes of Asia, Europe, and North America. "Major life zone" is the European phrase for the North American biome concept (<http://www.britannica.com>, accessed November 14, 2011).

and ecoregions define very large scale patterns, thus allowing for analysis at a continental or global scale, and are widely used by conservation agencies.

During the first part of the 20th century Clement and later Tansley<sup>(4)</sup> envisaged that in a given area, the assemblage of plant species would compete and replace each other such that eventually the dominant species would coexist in a stable climax (equilibrium/balance of nature), which would vary with the biotic and abiotic environment including the prevailing climate. This climax concept was soon after contested by Gleason who saw vegetation development as a stochastic process rather than as development as an organism, with communities composed of species with individual adaptations to the biotic and abiotic environment and thus with individual distributions. During the almost one hundred years since these ideas were conceived an enormous amount of studies and theoretical developments have modified our understanding of vegetation dynamics and it is unlikely that any scholar today would understand the term 'climax vegetation' in the same way as Clement and Tansley did. Already Whittaker (1962) in a review of the field of vegetation classification largely corroborated Gleason's view. This concept of the flux of nature led to interest in theories where disturbance is seen as a permanent feature of vegetation such as patch dynamics and patterns and processes in forest (Cadenasso *et al.*, 2003, Whitmore, 1982, van der Maarel, 1996). However, a non-equilibrium view does not preclude that there can be patterns of coinciding distribution of species, such that vegetation types can still be identified (Walker & Del Moral, 2003; Chadzon, 2008).

The concept of Potential Natural Vegetation (PNV) is part of this development of vegetation science. A widely accepted definition of PNV is: Potential natural vegetation has been defined as the vegetation structure that would become established if all successional sequences were completed without interference by man under the present climatic and edaphic conditions, including those created by man (van der Maarel, 2005). The term was coined by Tüxen in the middle of the 20th century (Tüxen, 1956) and has been applied in many parts of the world to categorise plant communities. The concept is closely related to the schools of phytosociology, which originated in Europe and elaborated methods for vegetation analysis and detailed and often hierarchical systems of classification of vegetation by floristic and physiognomic characteristics (see reviews by van der Maarel, 2005; Whittaker, 1980). We do not consider the reintroduction of the PNV concept as a statement about the degree of niche assembly of ecological communities versus a stochastic neutral theory (*sensu* Hubbell, 2008) but as a tangible hypothesis about species distributions.

We believe that there is truth in the concepts of climax and PNV as well as in the critique and that for practical conservation and management of vegetation and species this discussion should not only be a theoretical discussion, but should lead to a more informed interpretation of 'real' landscapes. The dichotomy between the continuum concept and the concept of communities as co-occurring species can in principle be solved by considering the two concepts as two different and complementary ways of looking at the same landscape (after Austin, 2005, pp. 66-67): The continuum

4: **Ecosystem**, the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space. The concept of ecosystems, introduced by Tansley, not only considers the complex of living organisms and their physical environment, but also all their relationships in a particular unit of space (<http://www.britannica.com>, accessed November 14, 2011).



concept applies to an abstract environmental space, not necessarily to any geographical distance on the ground or to any indirect environmental gradient. The abstract concept of community of co-occurring species can only be relevant to a particular landscape and its pattern of environmental variables, community is a property of the landscape. Such a community concept is compatible with the different concepts of a continuum. The PNV map thus offers a useful tool in lieu of missing environmental relationships. For the forests we have been careful not to map the detailed variation of the forest types, but have kept the physiognomic and chorological classification of White (1983). As pointed out by Langdale Brown and Omaston “The forests are characterised by a great variety of species and communities. Sometimes edaphic or seral relationships between these types are clear, but we cannot yet account for all the differences. Indeed these tropical forests are such complex and longlived communities that in many cases it is not yet possible to be sure what is the climax; even the very nature and constancy of the climax is in doubt.” (Langdale Brown & Omaston, 1964 p. 36).

The ‘Clementian’ traits of interpreting PNVs are in particular (i) the use of rigid hierarchical systems of classification together with a rigid prescription of species composition, and (ii) a static view that there can be only one end-point to succession. We suggest that the PNV concept should not be interpreted in terms of a static ‘Clementian’ paradigm and we have been helped in this by the non-hierarchical classification utilised by White. The largest part of the VECEA region is covered by dry vegetation where fire and large browsers (megaherbivores) have profound influence on vegetation development (Bond *et al.*, 2005, Owen-Smith, 1987) and there may in most cases be more than one stable state for the vegetation of a particular area. The use of PNV can thus be an aid in interpreting the dynamics of vegetation and likely alternative stable states. In the Serengeti-Mara area the possibility of alternative stable states has been convincingly documented (Sinclair *et al.*, 2007, McNaughton *et al.*, 1988, Dublin *et al.*, 1990) and the VECEA map could be a tool for identifying alternative stable states in other areas.

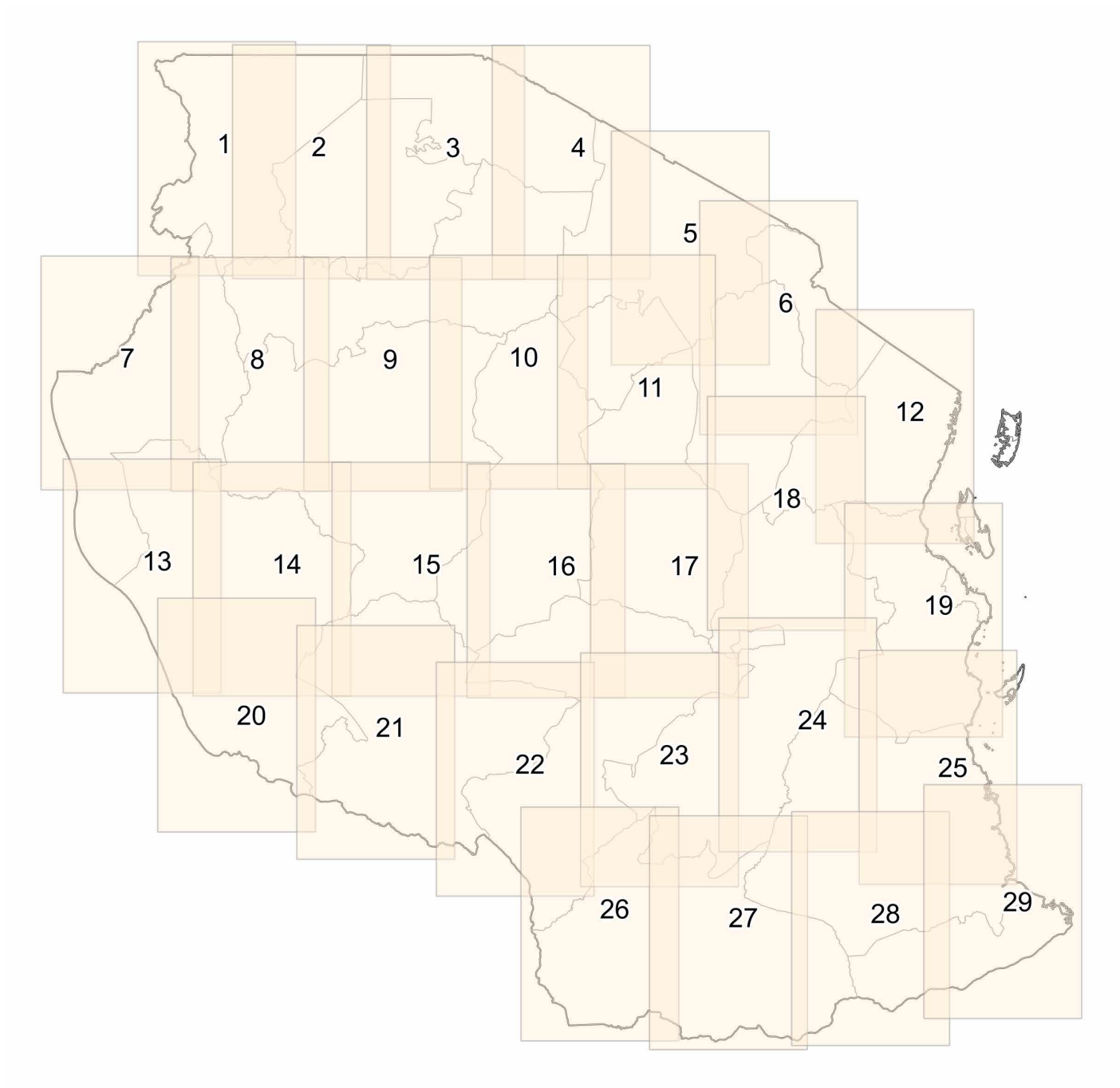
With the VECEA vegetation map we suggest that the interpretation of landscapes is done at such a resolution that the implications of analyses can be transferred directly to the landscapes. In making a map with this level of detail we have entered the domain of the contested concepts (climax, continuum, species assembly rules, non-equilibrium communities, etc), which may otherwise be avoided at the biome/ecoregional level of analysis (but not in the implementation and management of patterns and processes in actual landscapes). We do not claim that we have completely solved the conundrum with our map, but we trust that we have created a tool that can be an aid in biogeographical analyses.

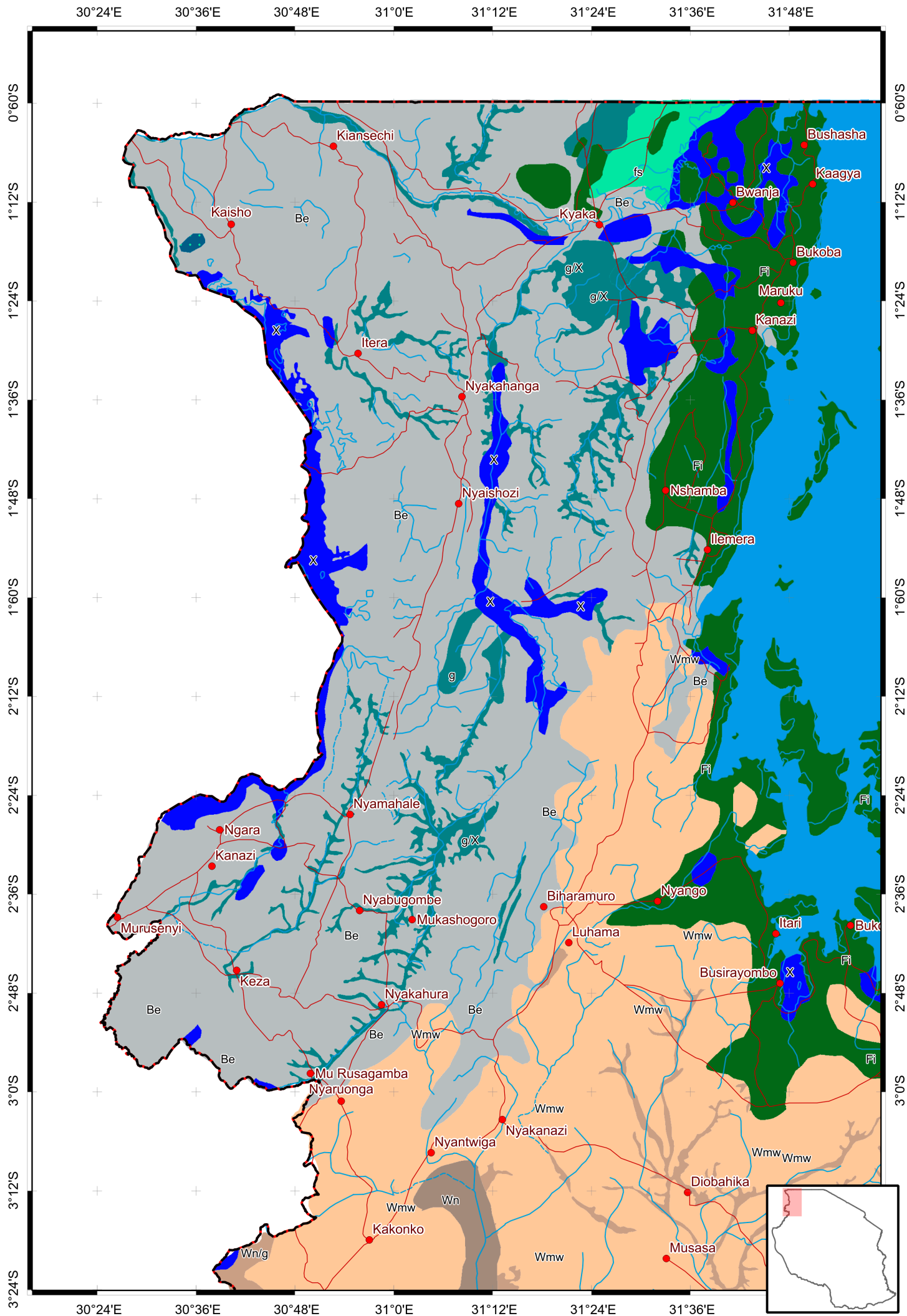
When the concepts, biome, plant community, and PNV are defined very loosely (as they are often used in practice) they are almost interchangeable in the sense that they all attempt to describe the variation in vegetation that can be experienced as one moves through a landscape. The use of the two first concepts is rarely questioned - because of the underlying objectives and the scale at which they are used – as they are rarely utilised in a context

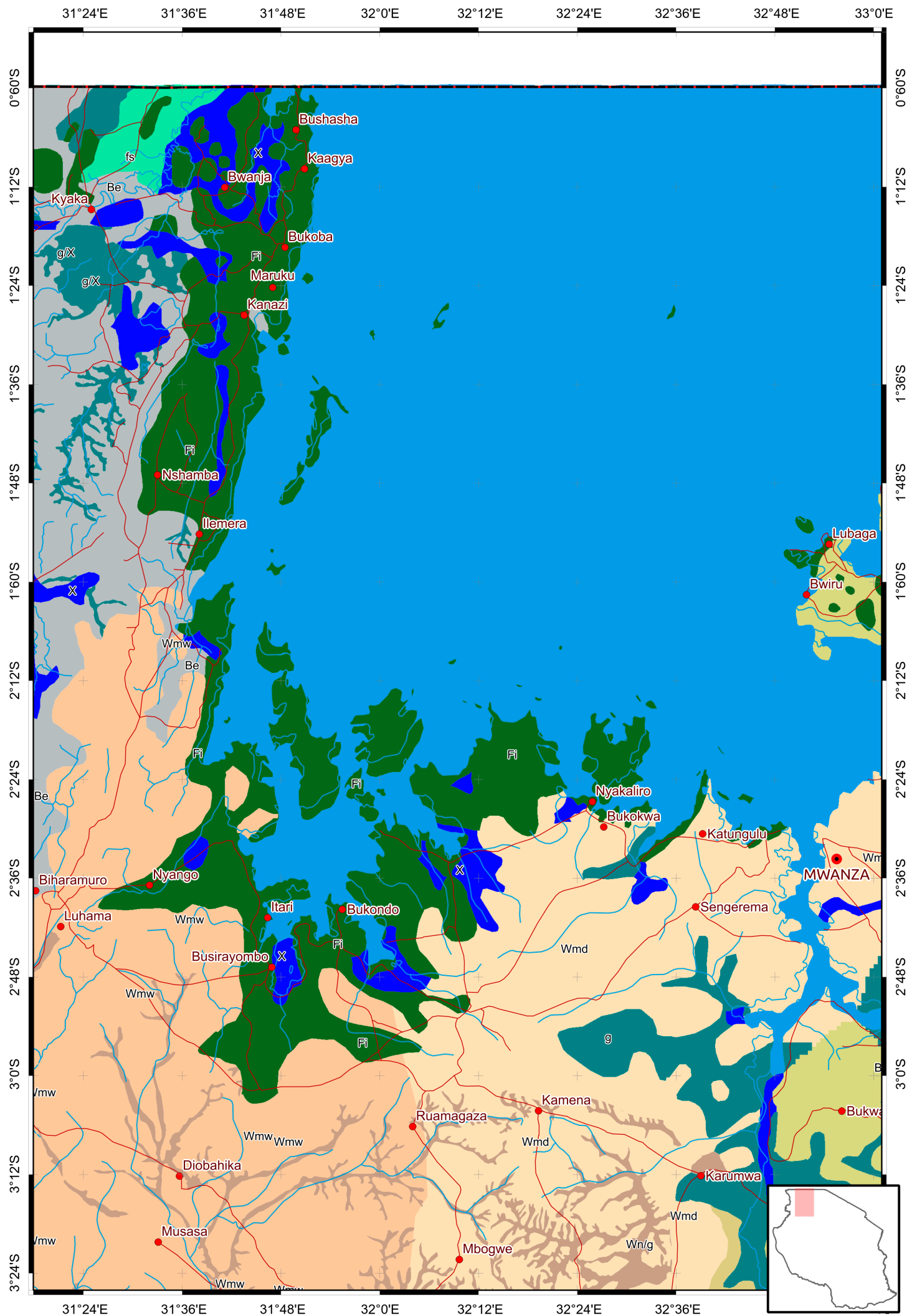
where they need to be applied in a particular landscape. PNV on the other hand, by nature of its use to describe plant communities on large scale, immediately invokes an interpretation of pattern and process. Like the concept of chorology, the concept of PNV is logical, but the criteria utilised can not be completely objective in the strictest sense. This is to us an acceptable compromise, since nature includes a large degree of history and chance and we suggest that the PNVs are tested and corroborated through empirical tests as well as modelling.

The PNV concept offers a tool that can be utilised in analysing the pattern and processes in landscapes including the biotic and abiotic interrelationships that govern these ecosystem aspects. As such it complements and can be used as an input to modelling of ecosystems and individual species. Although we are confident that the VECEA map provides a realistic picture of where particular vegetation types occur, the map still is a hypothesis about what the actual vegetation type will be. This is an inherent consequence of trying to map anything.

## **4. Maps of Tanzania**

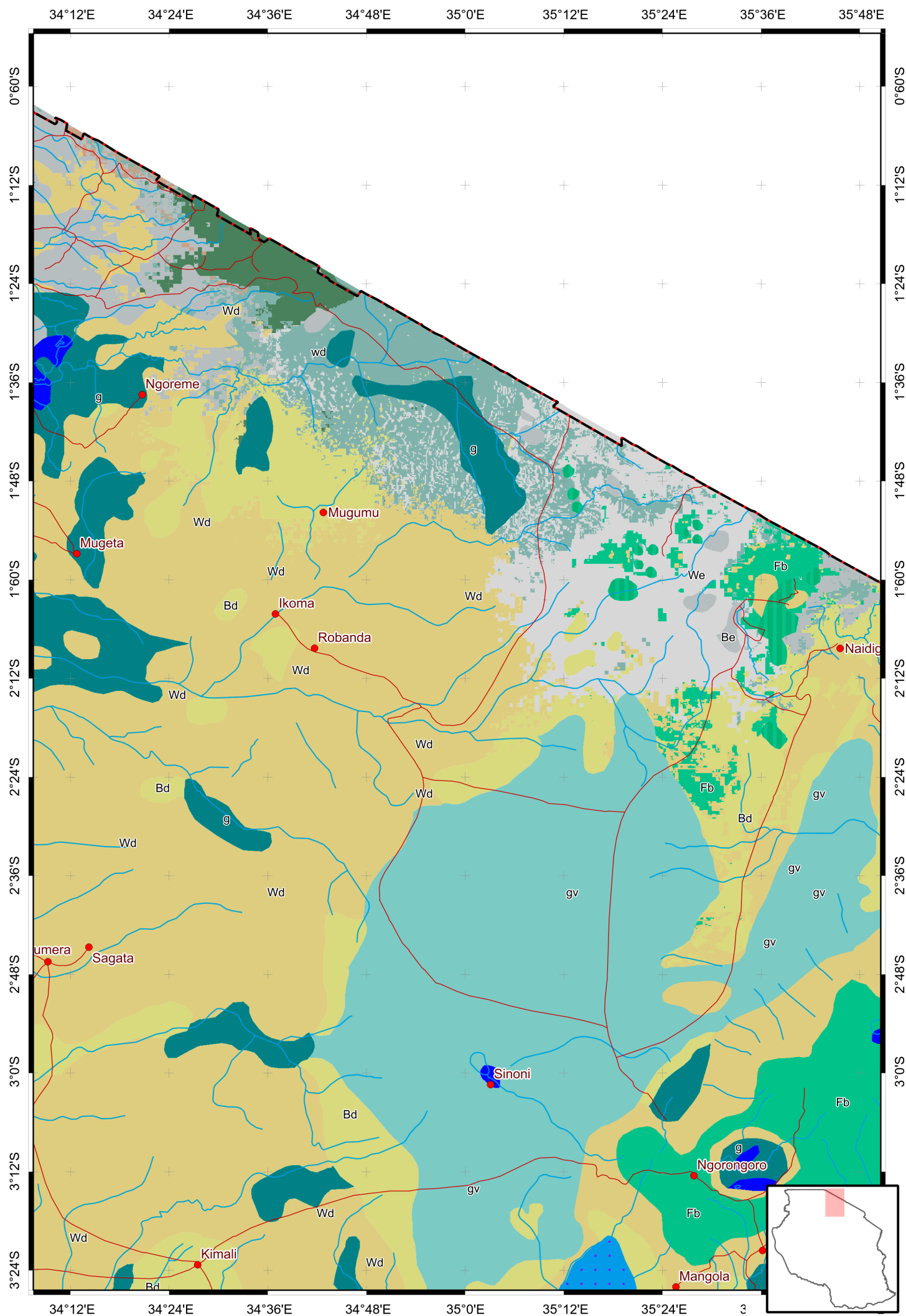




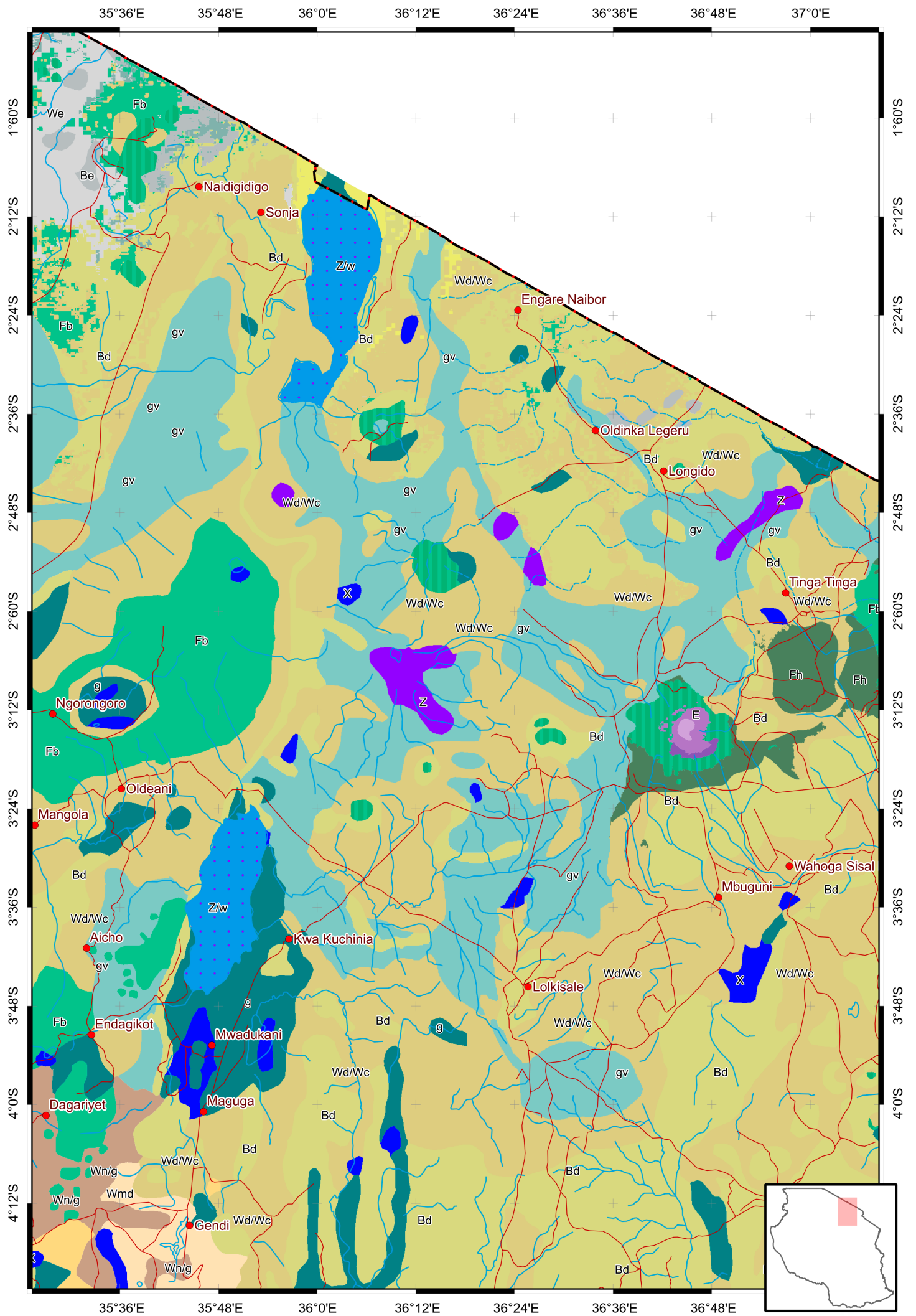


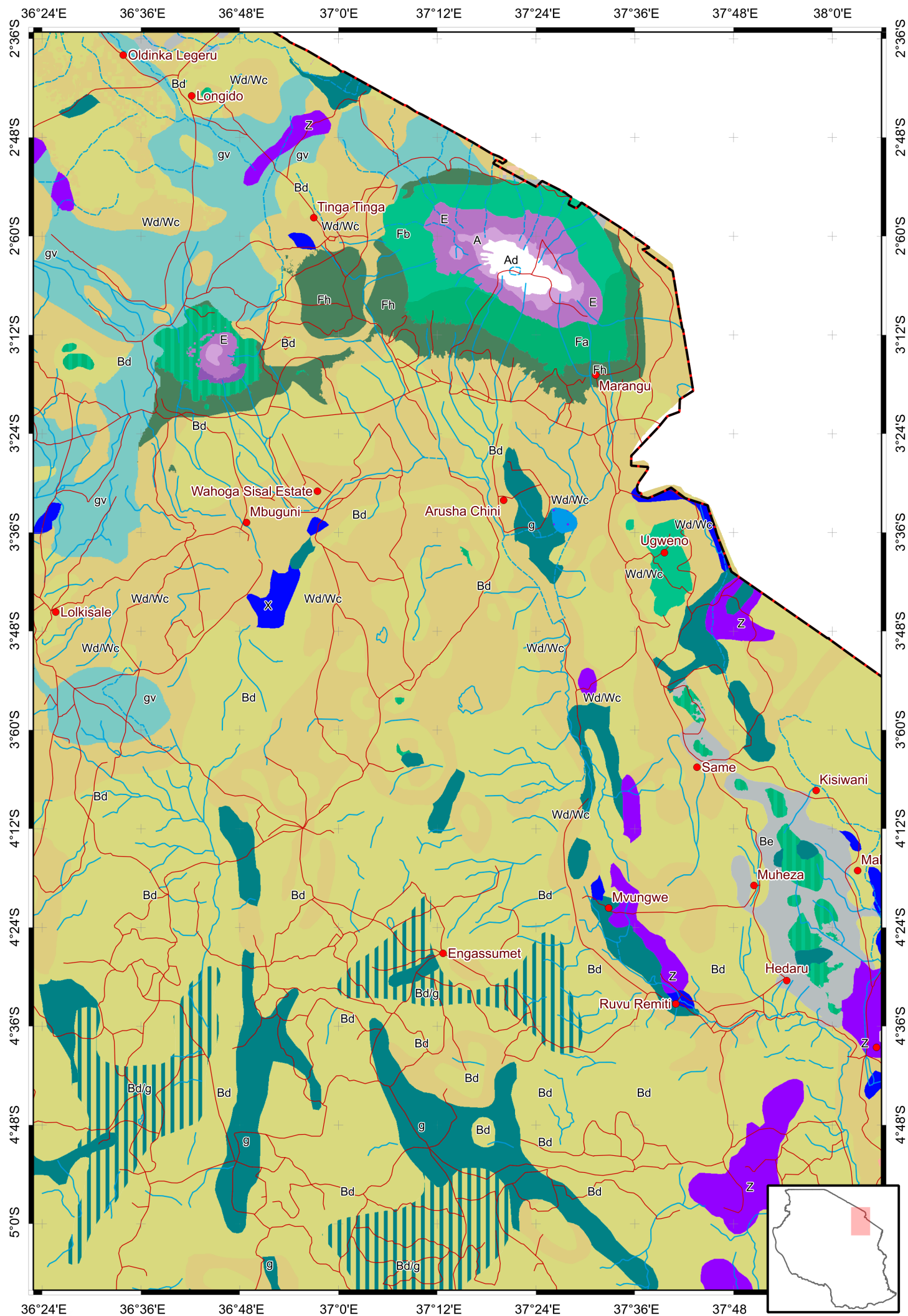


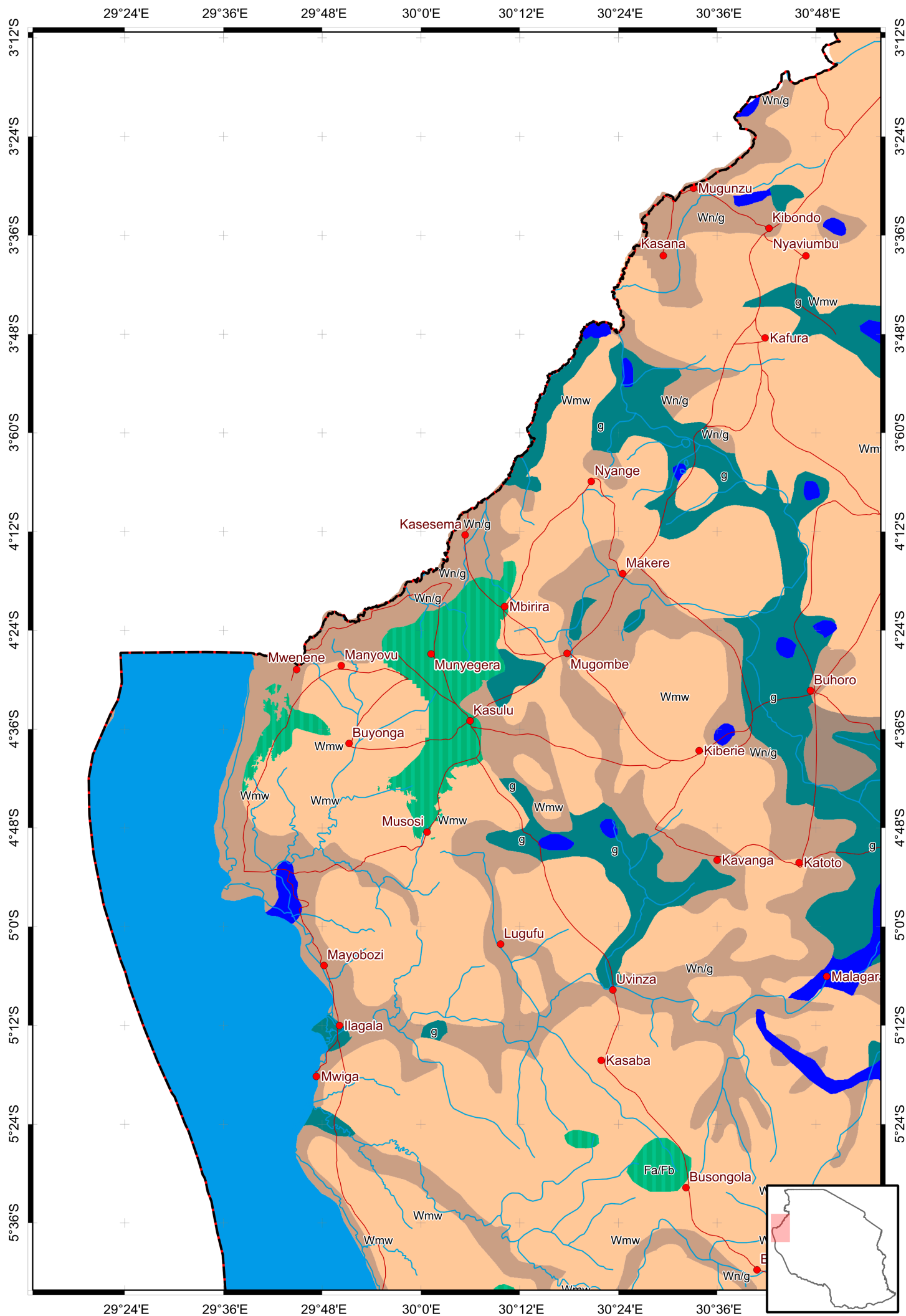




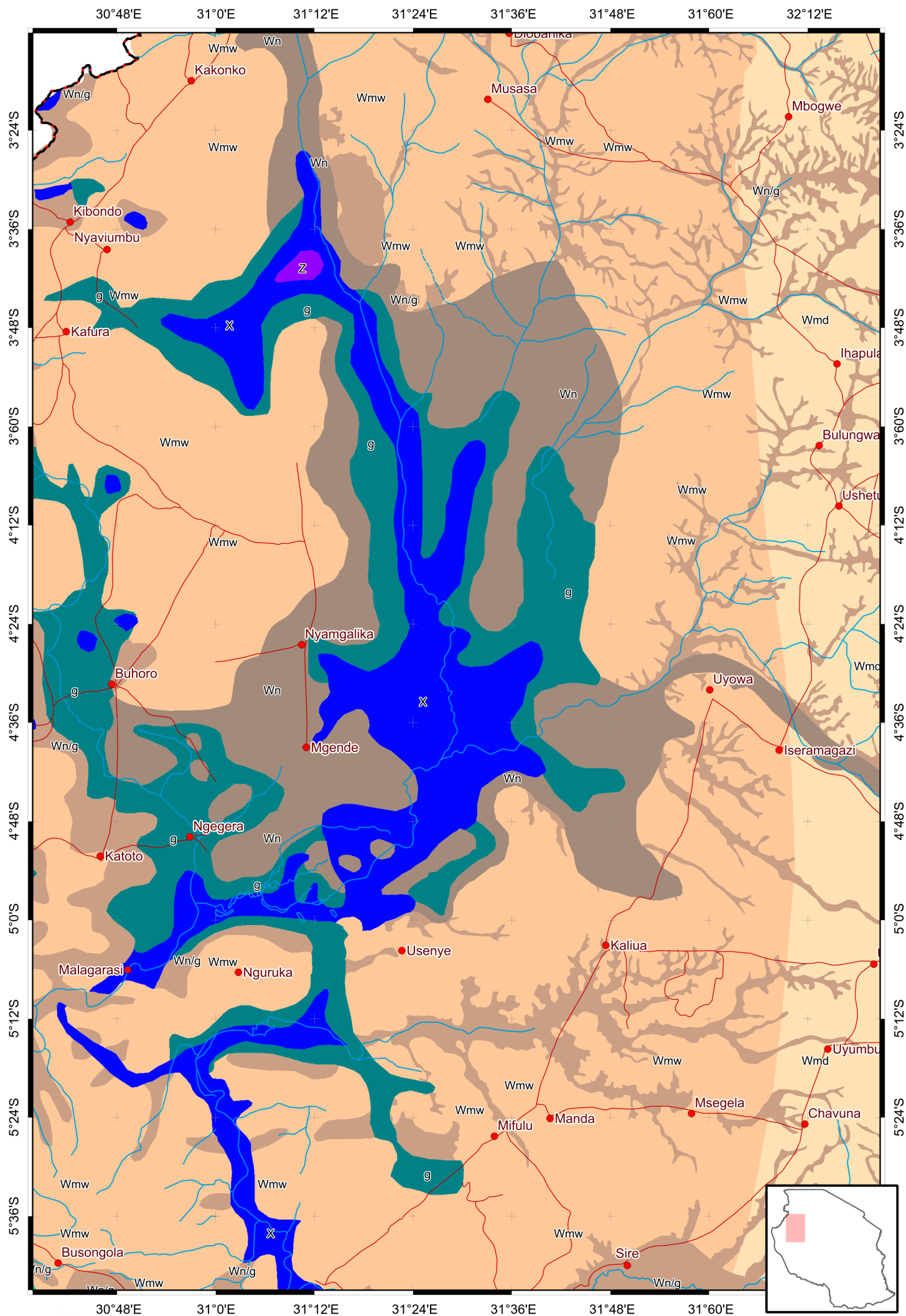


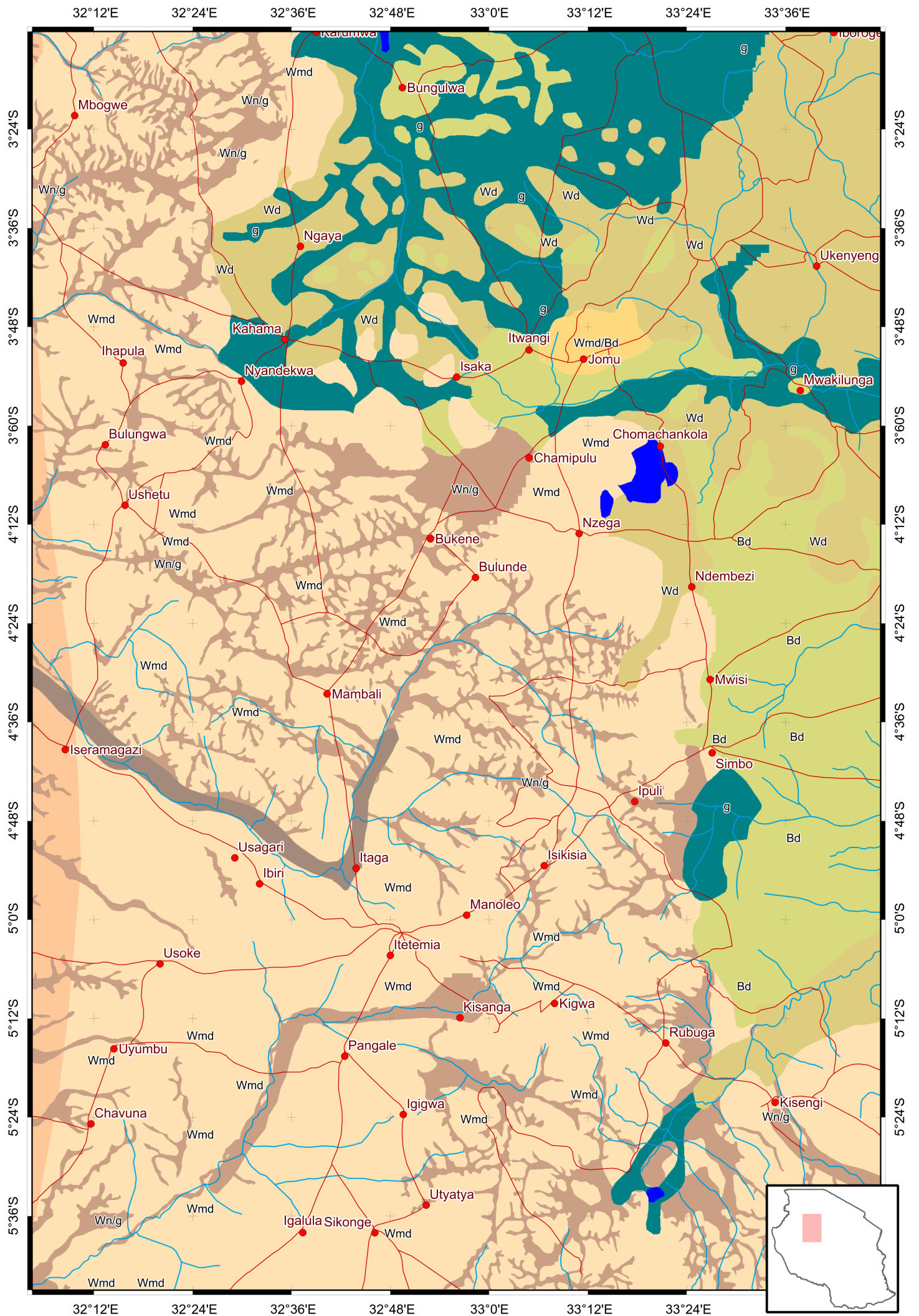


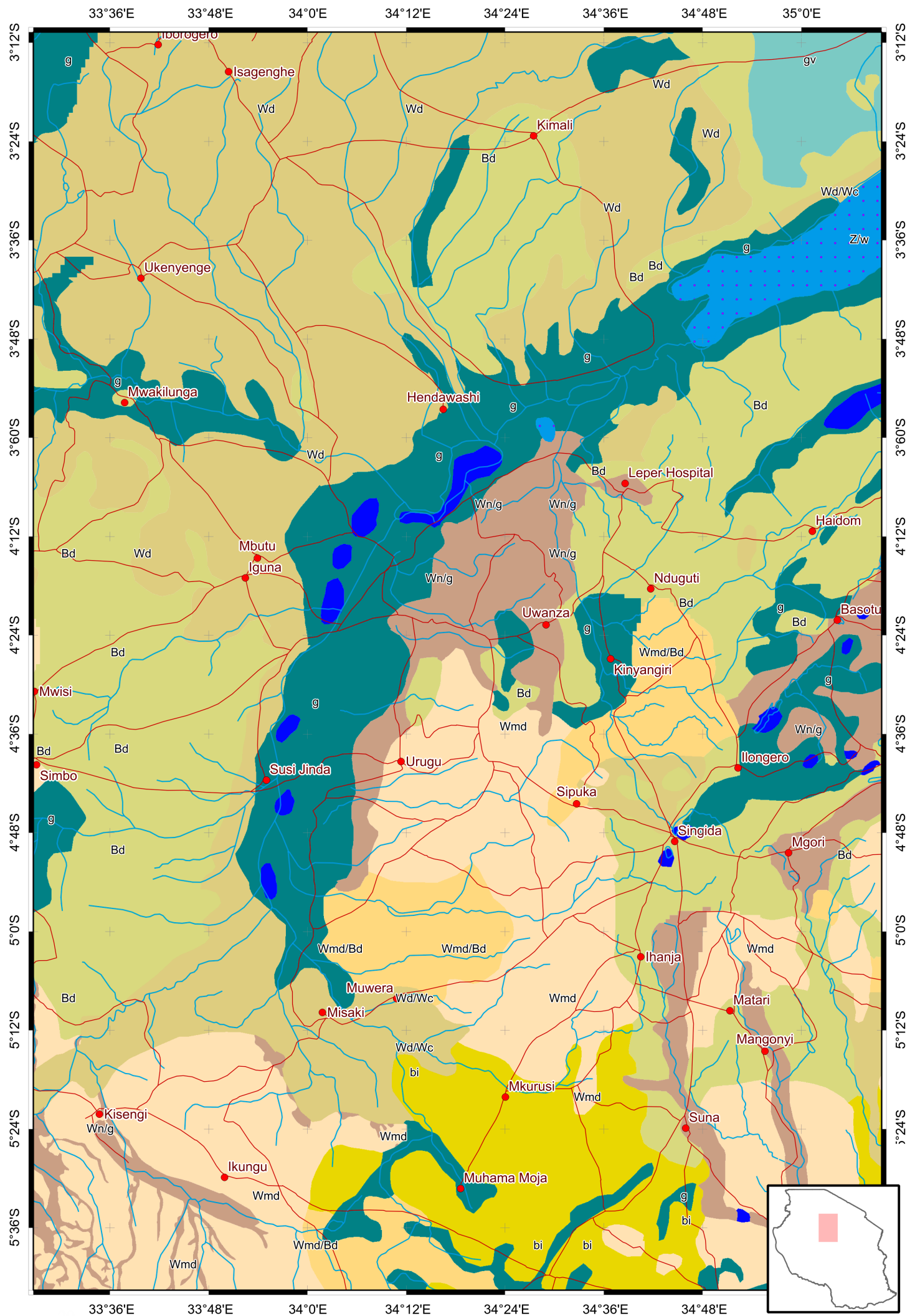




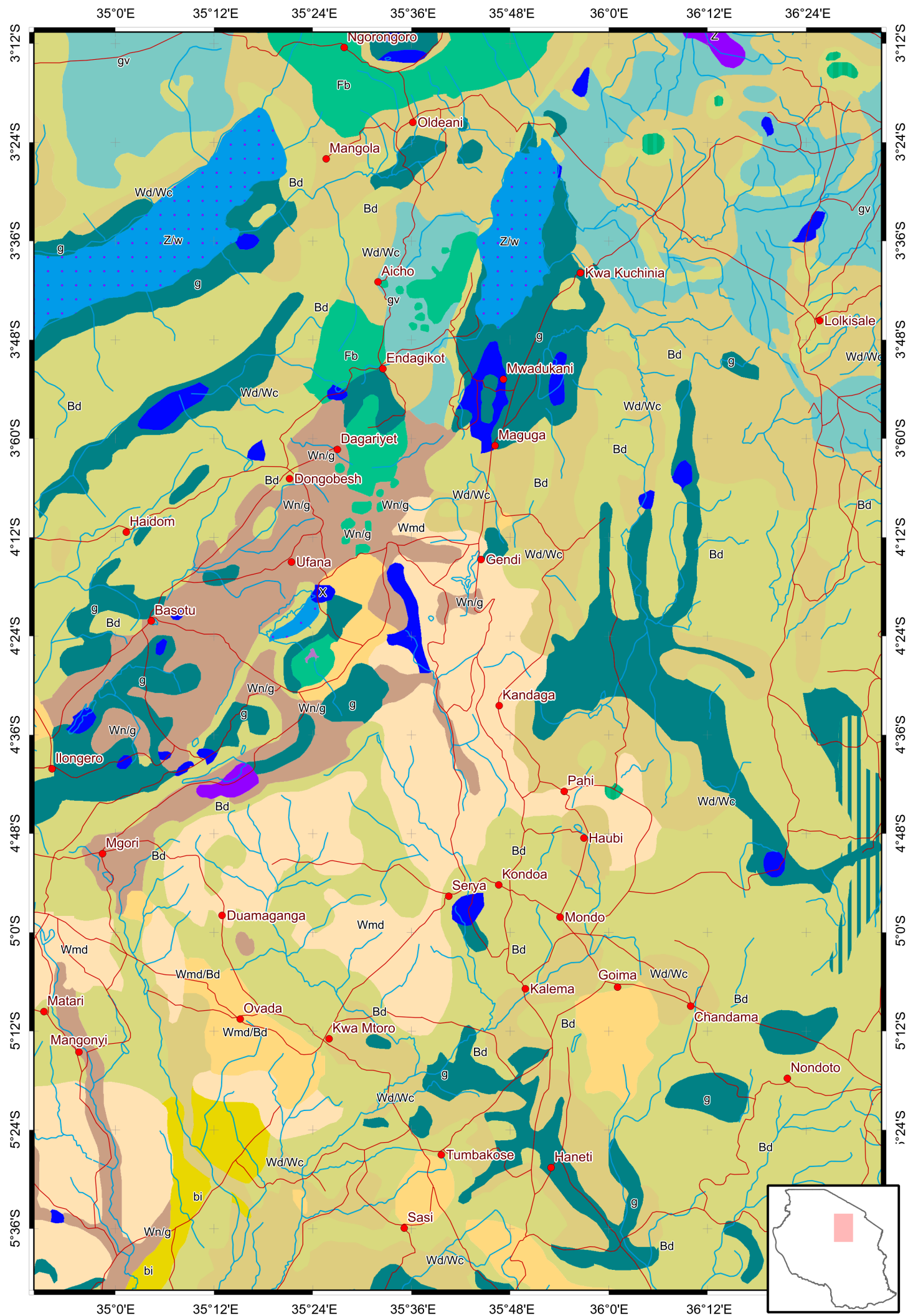


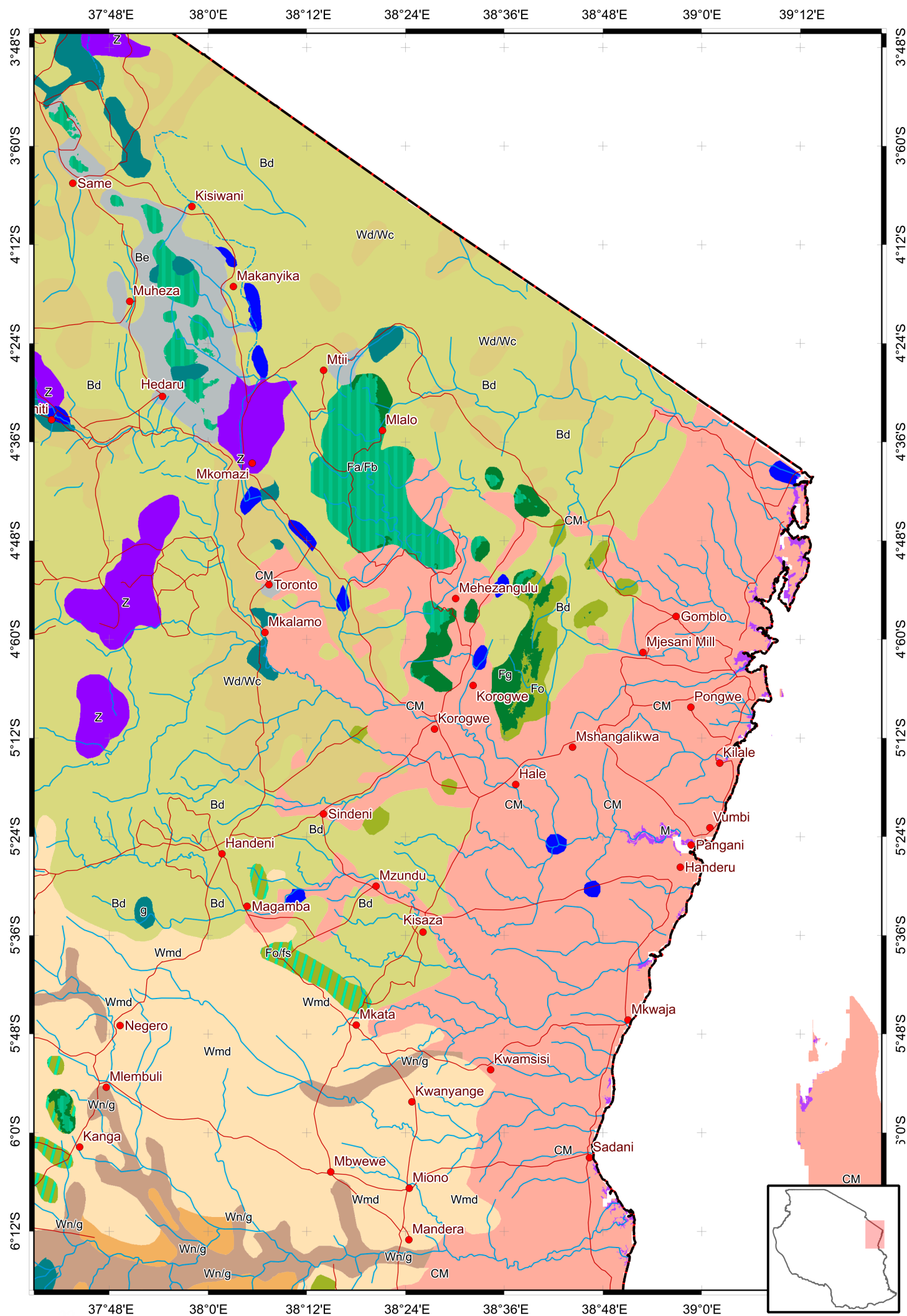




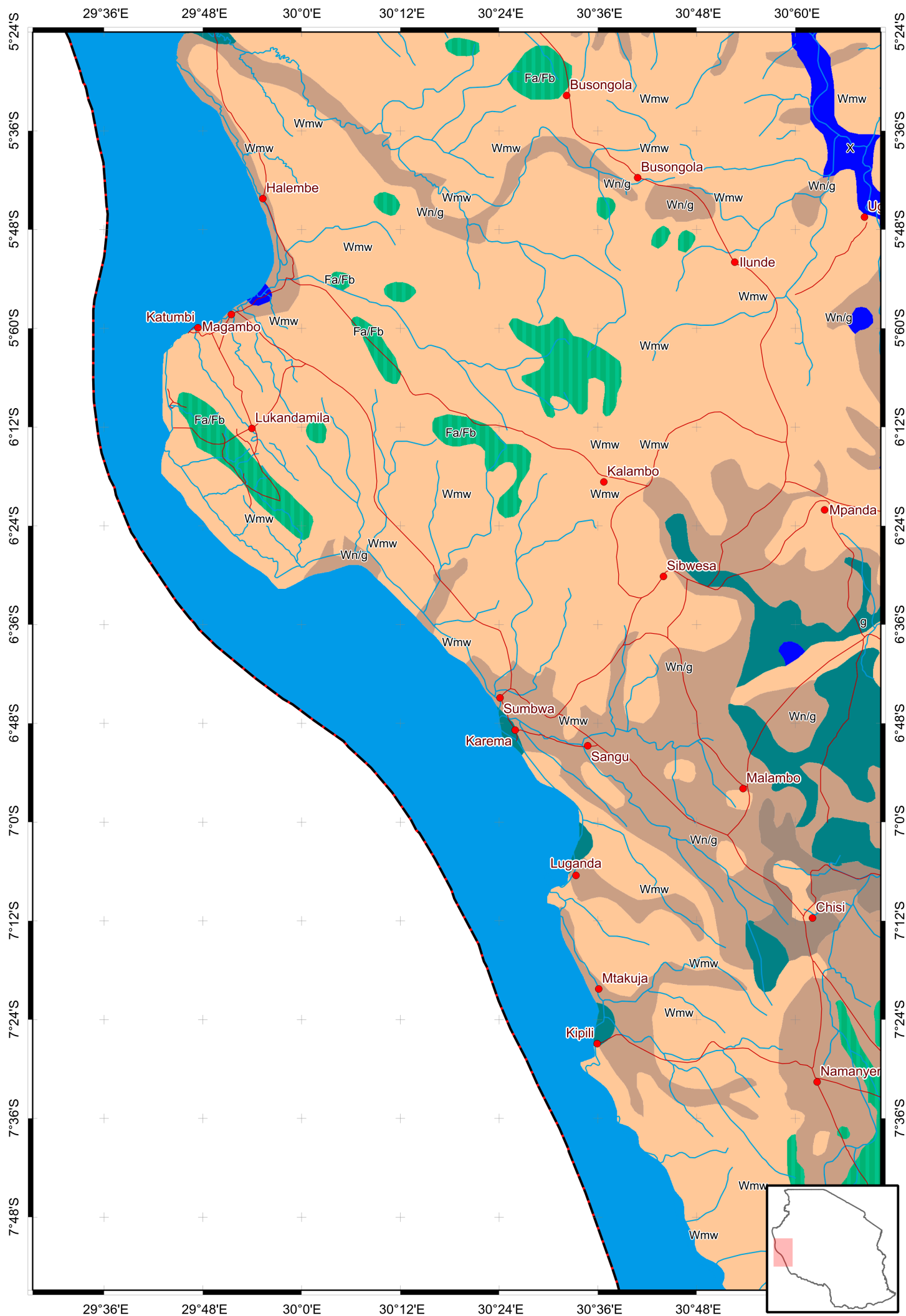


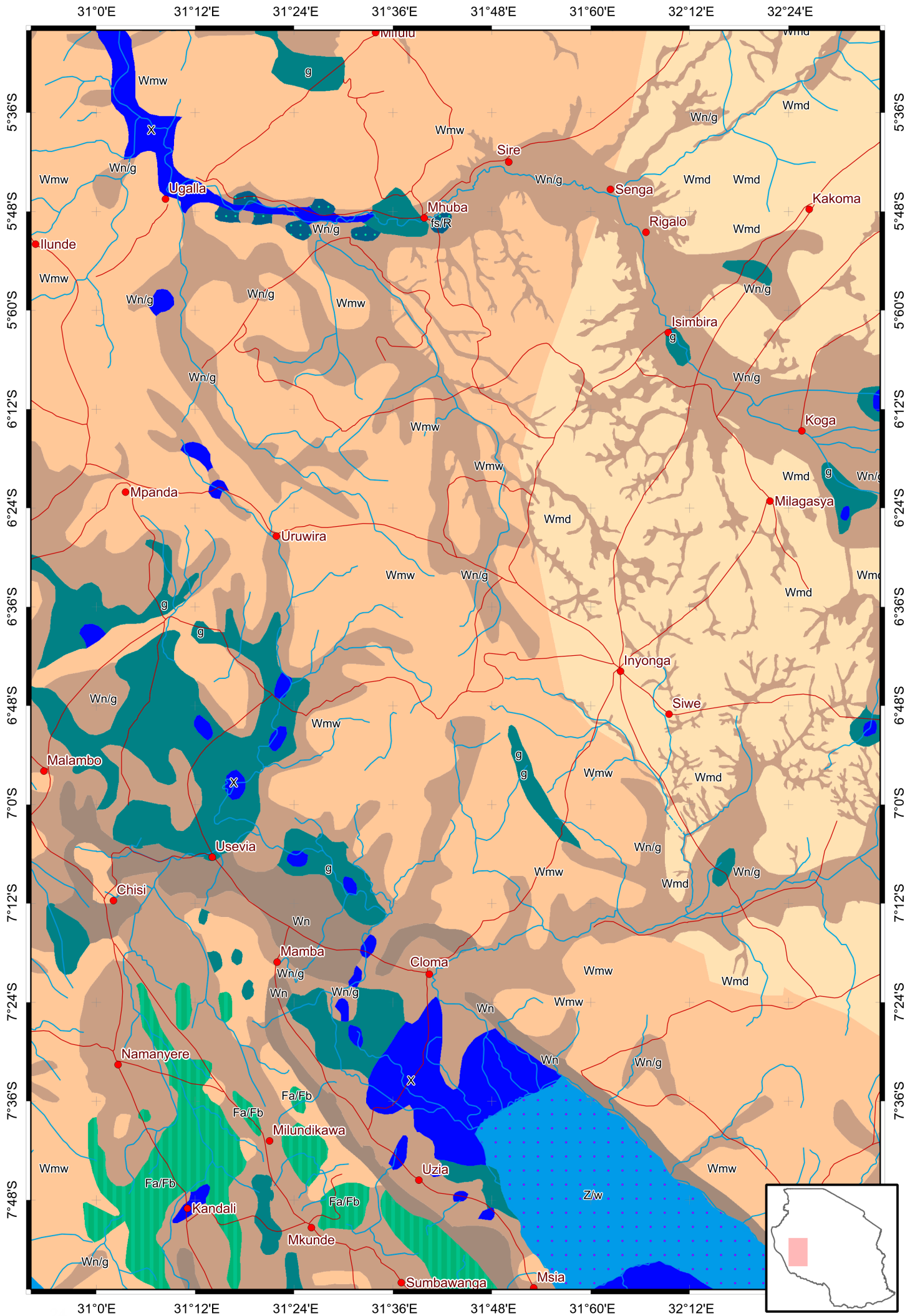


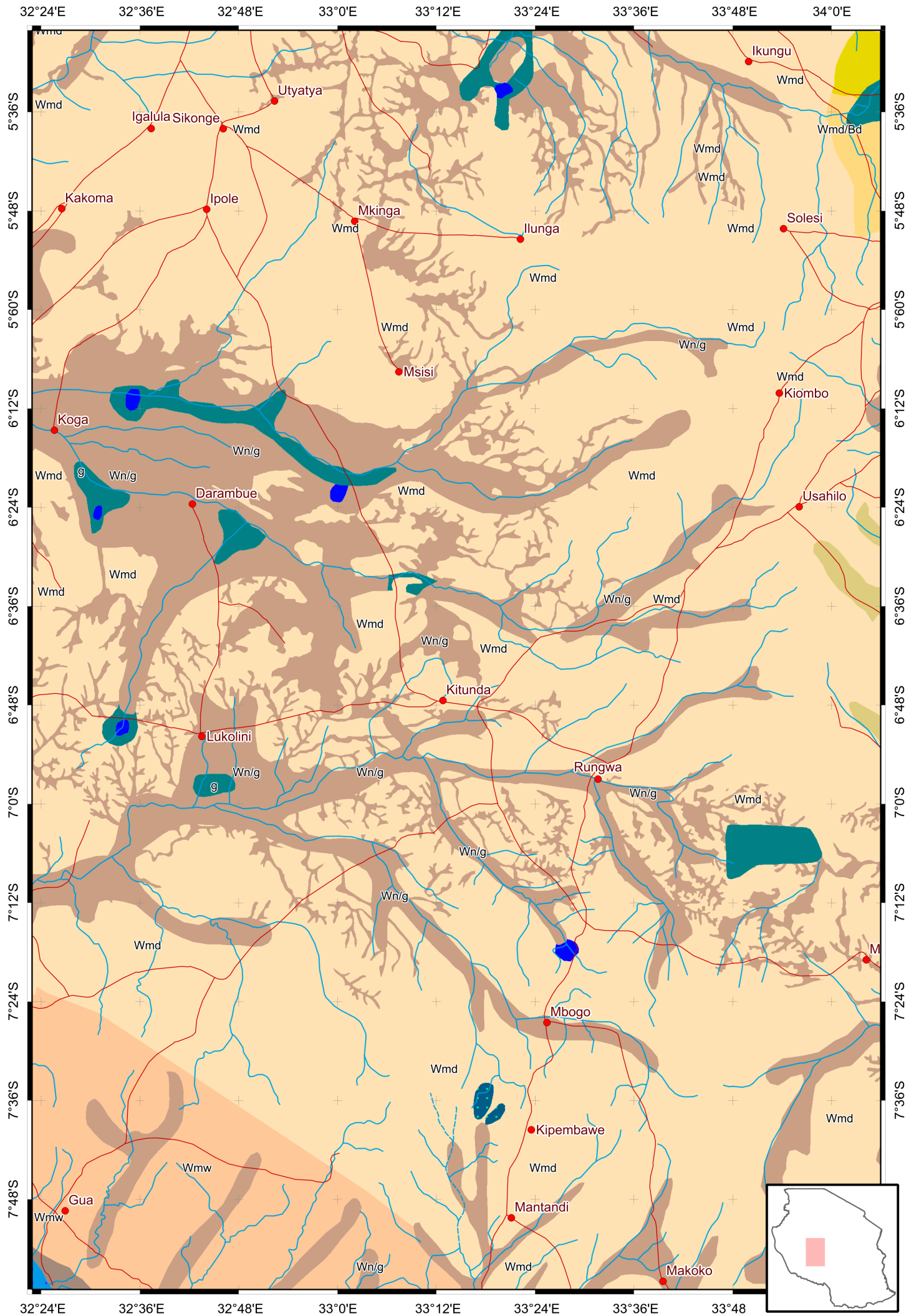




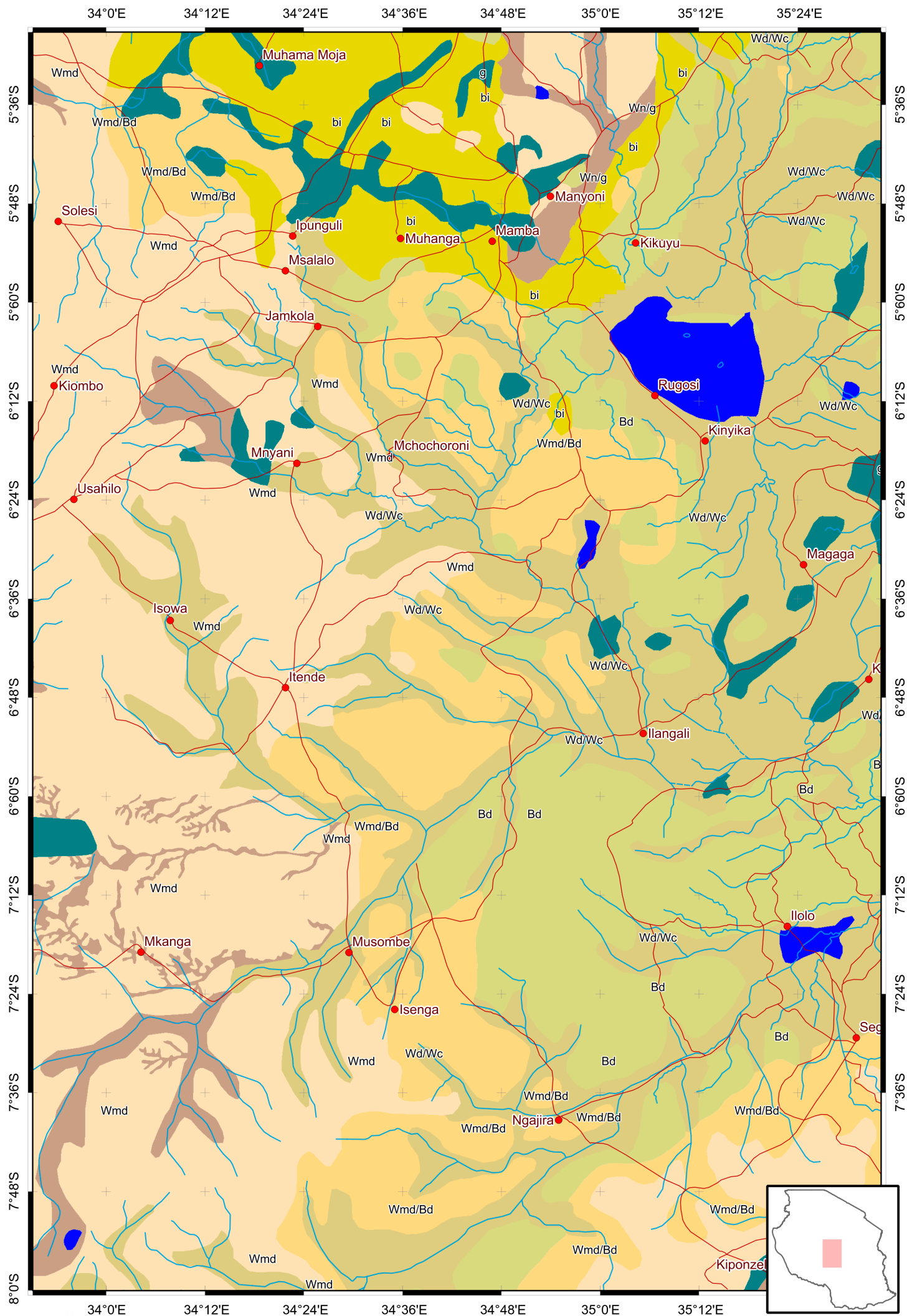


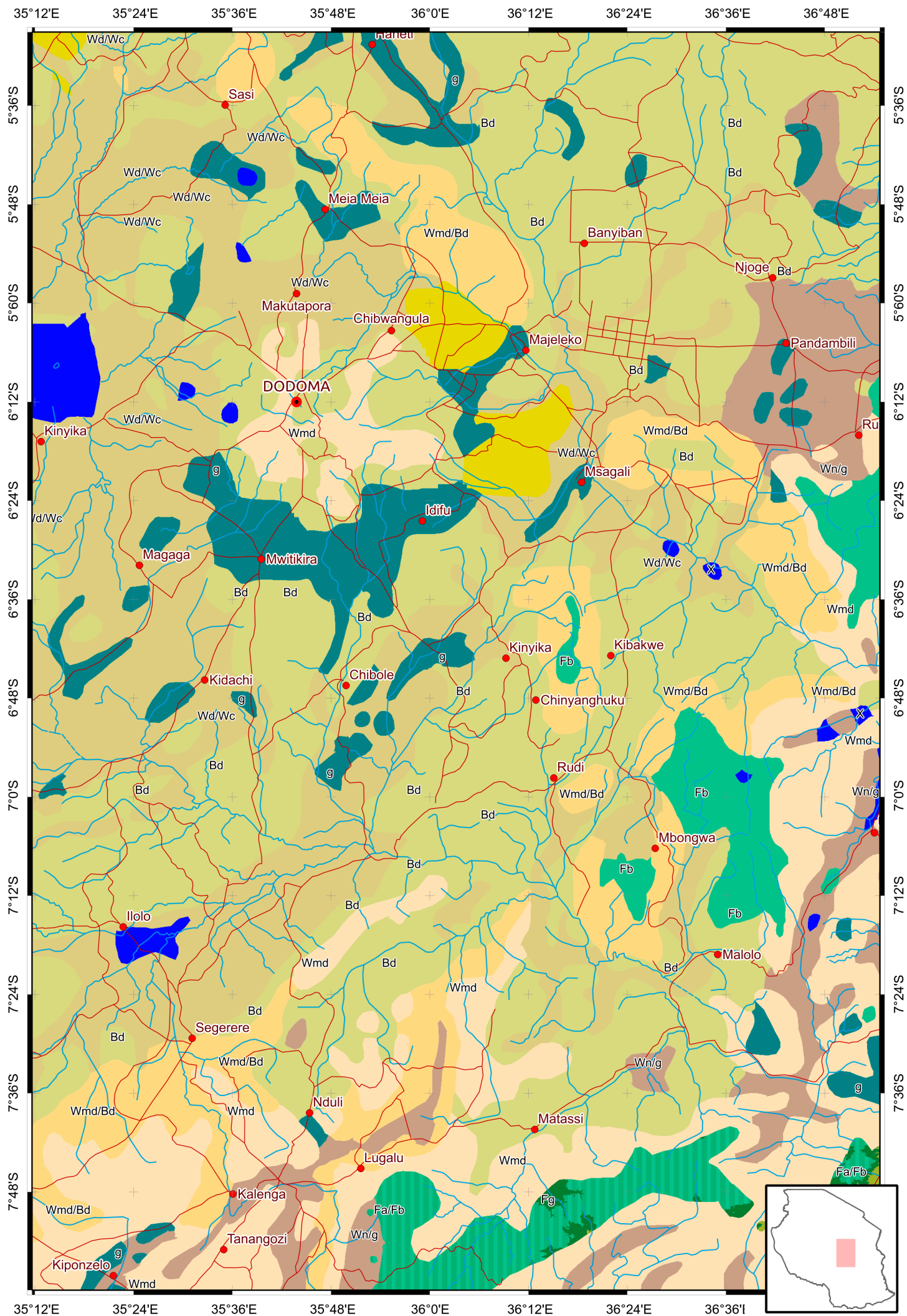




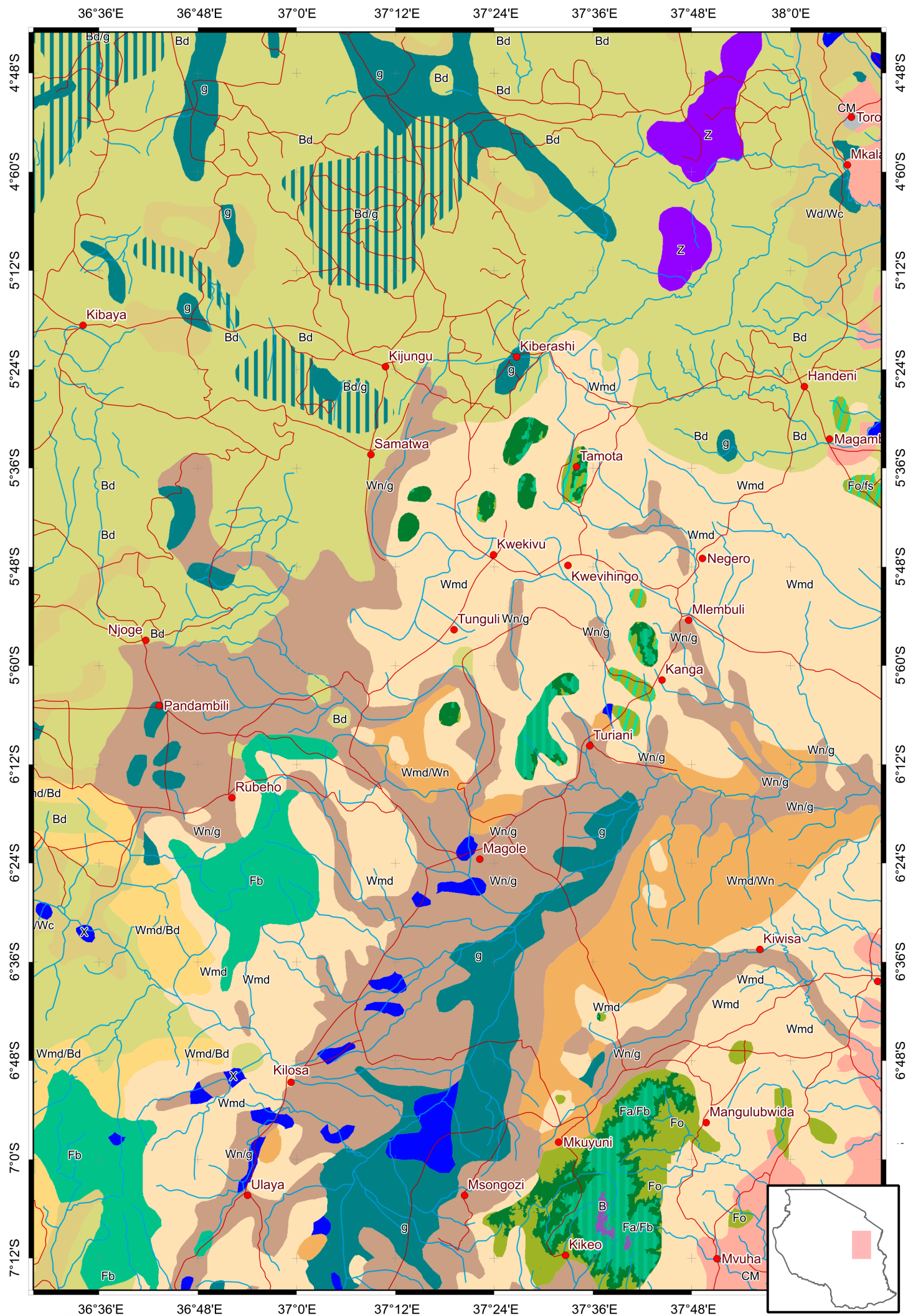


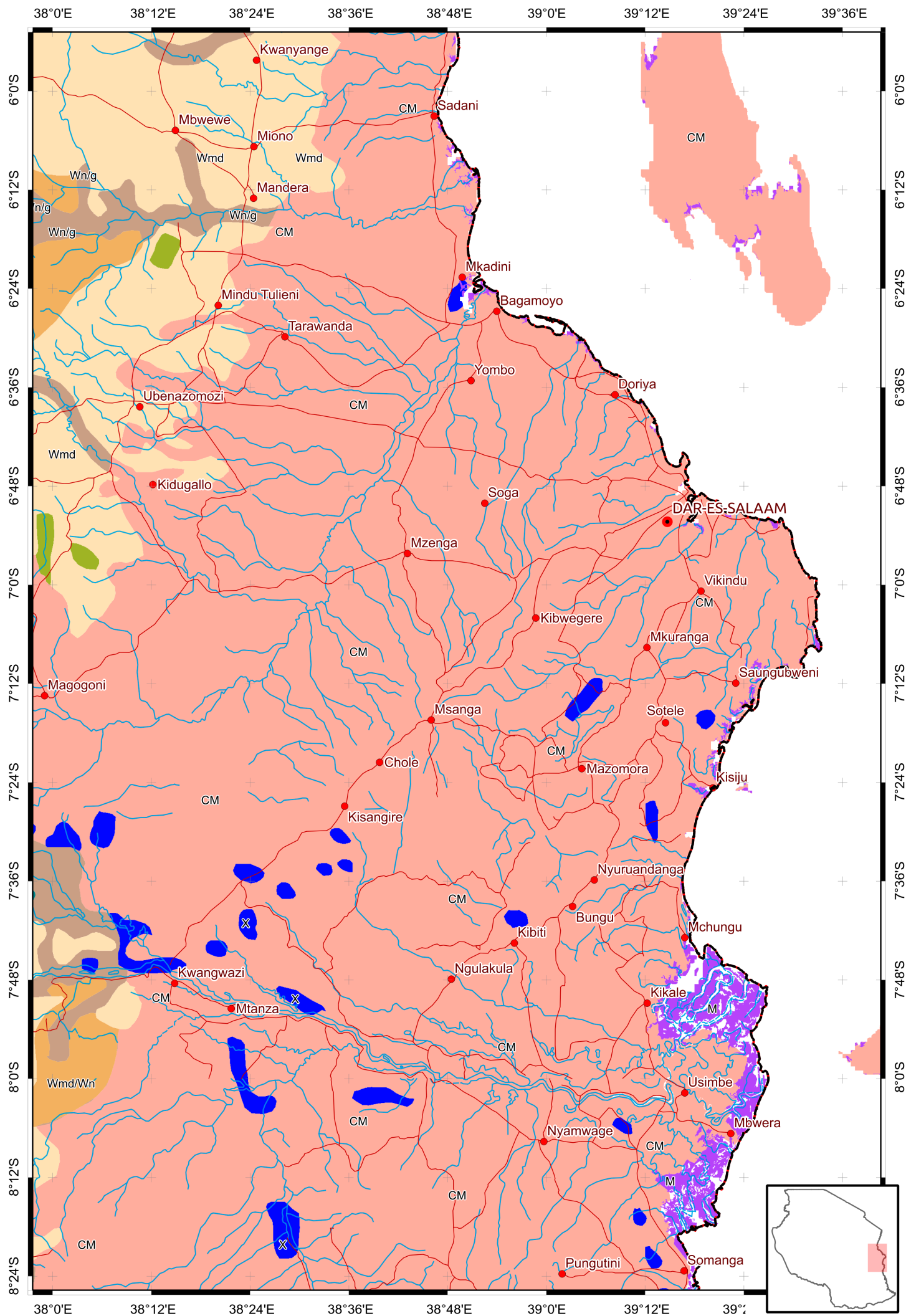


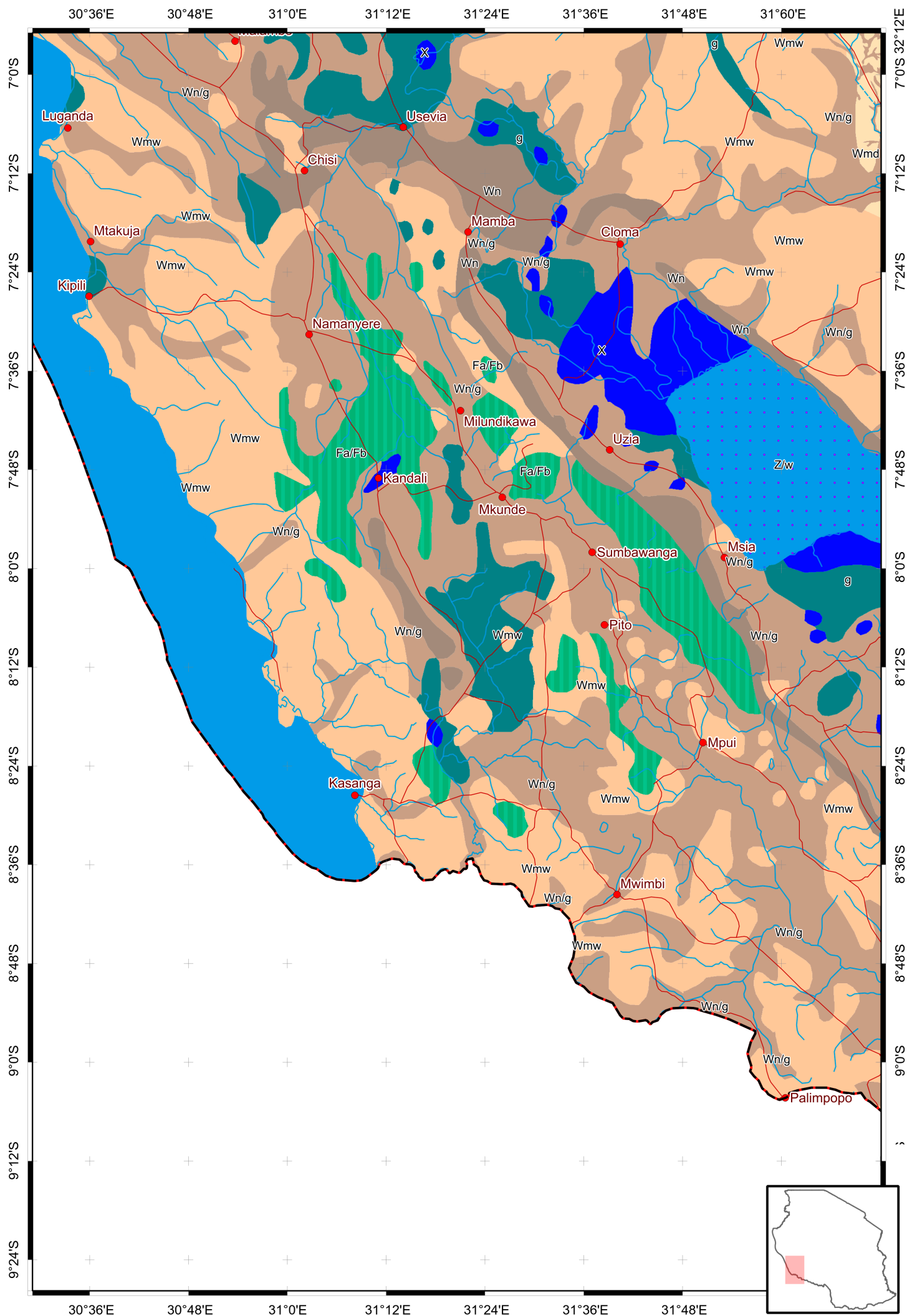




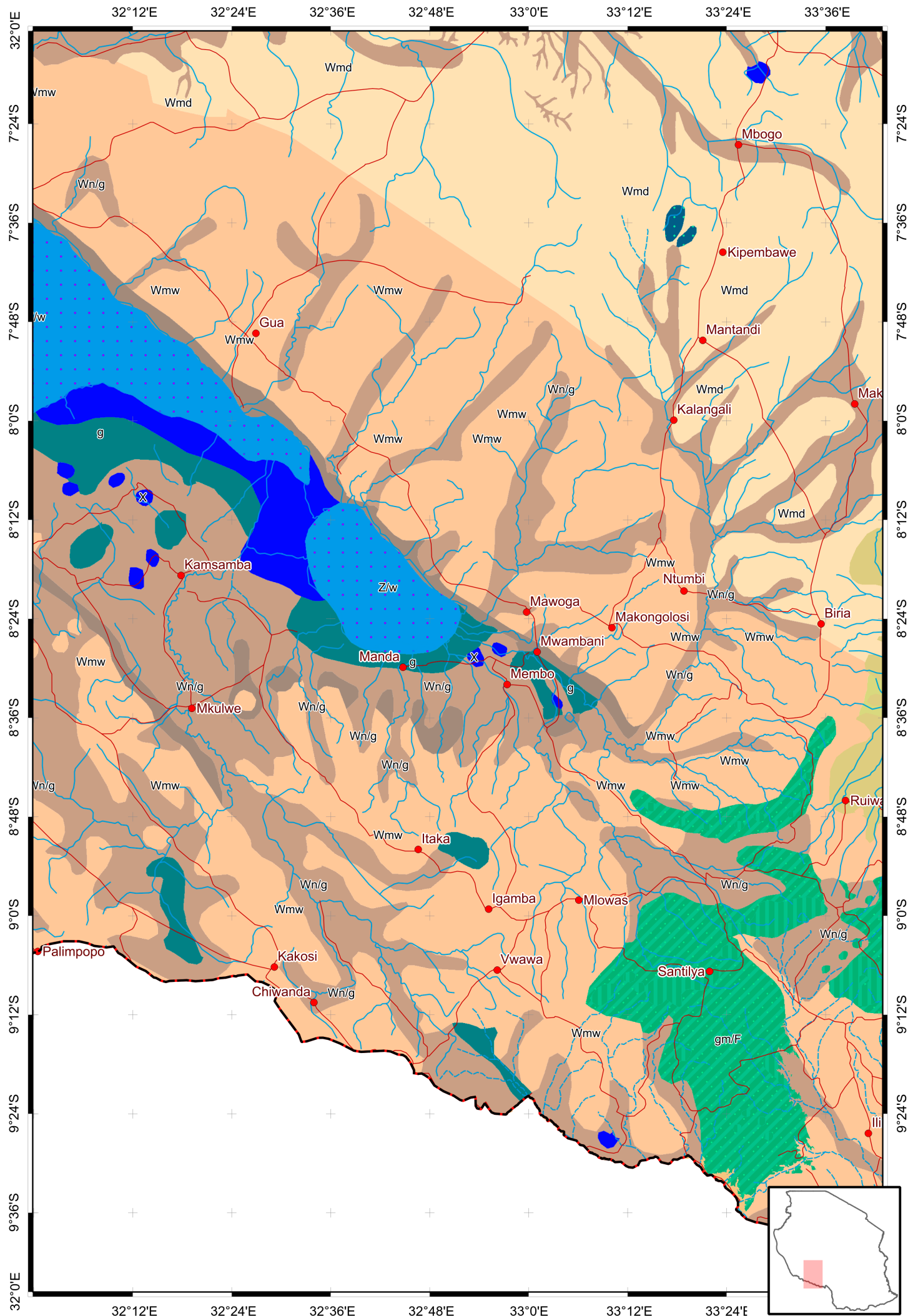


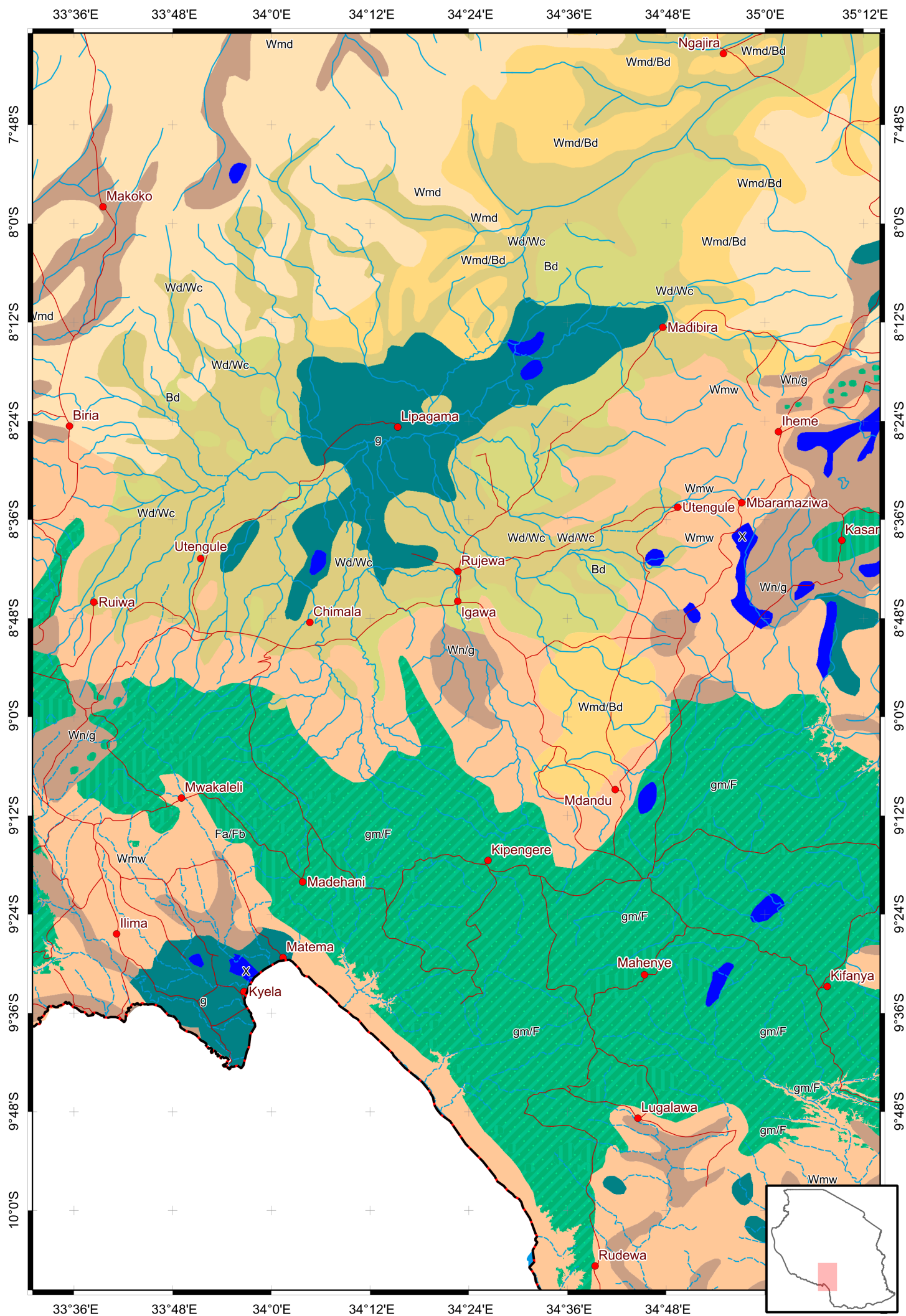




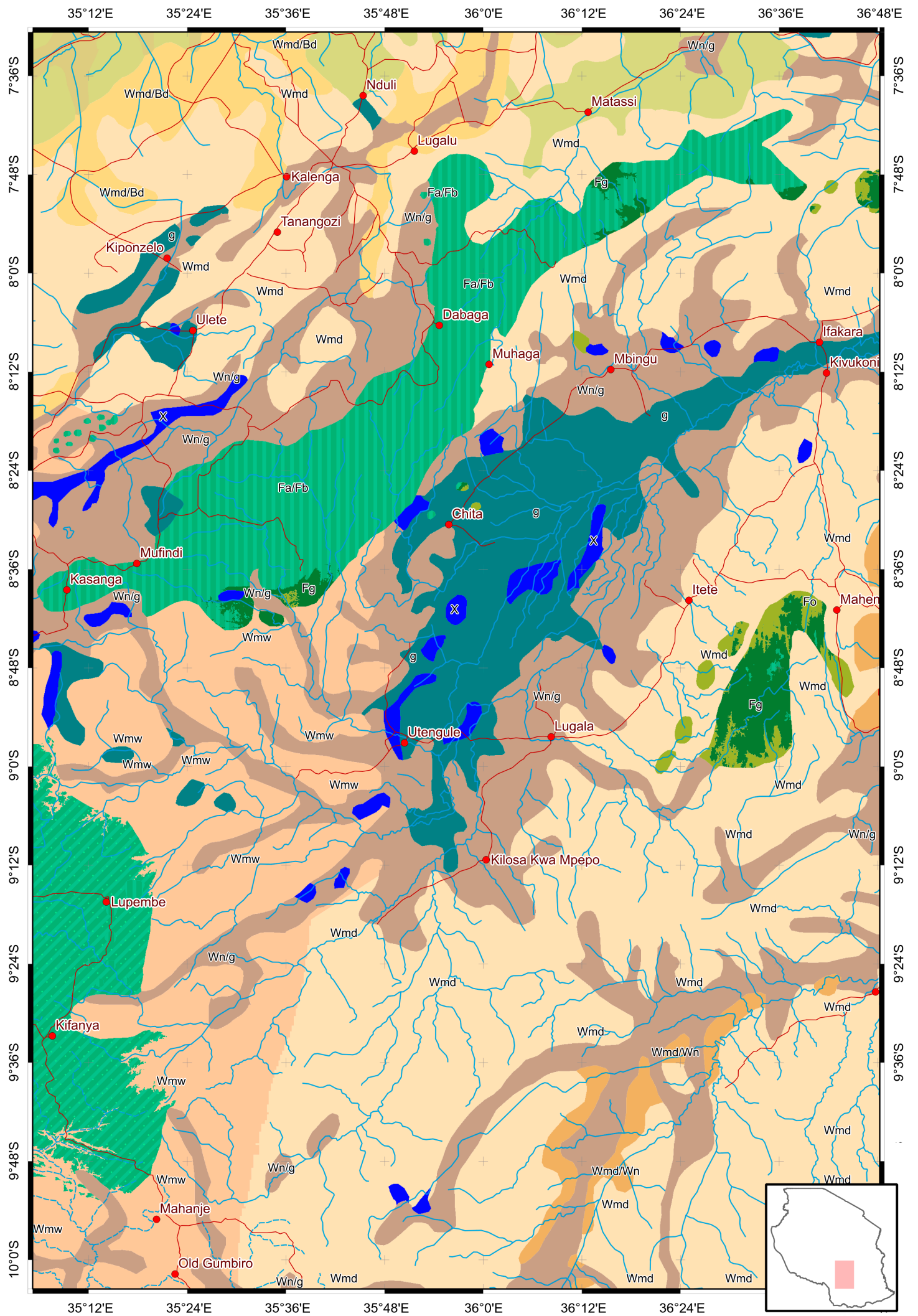


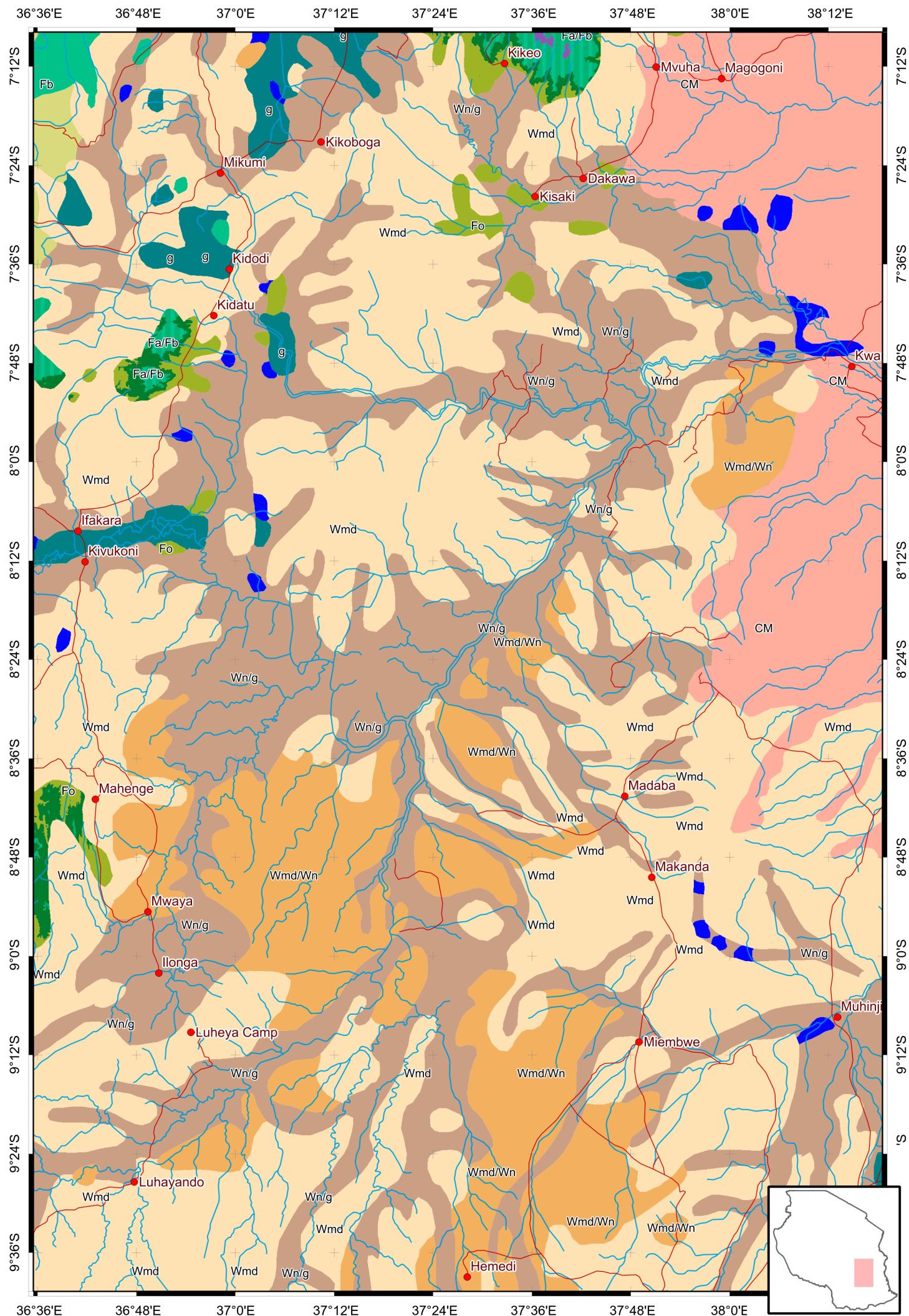




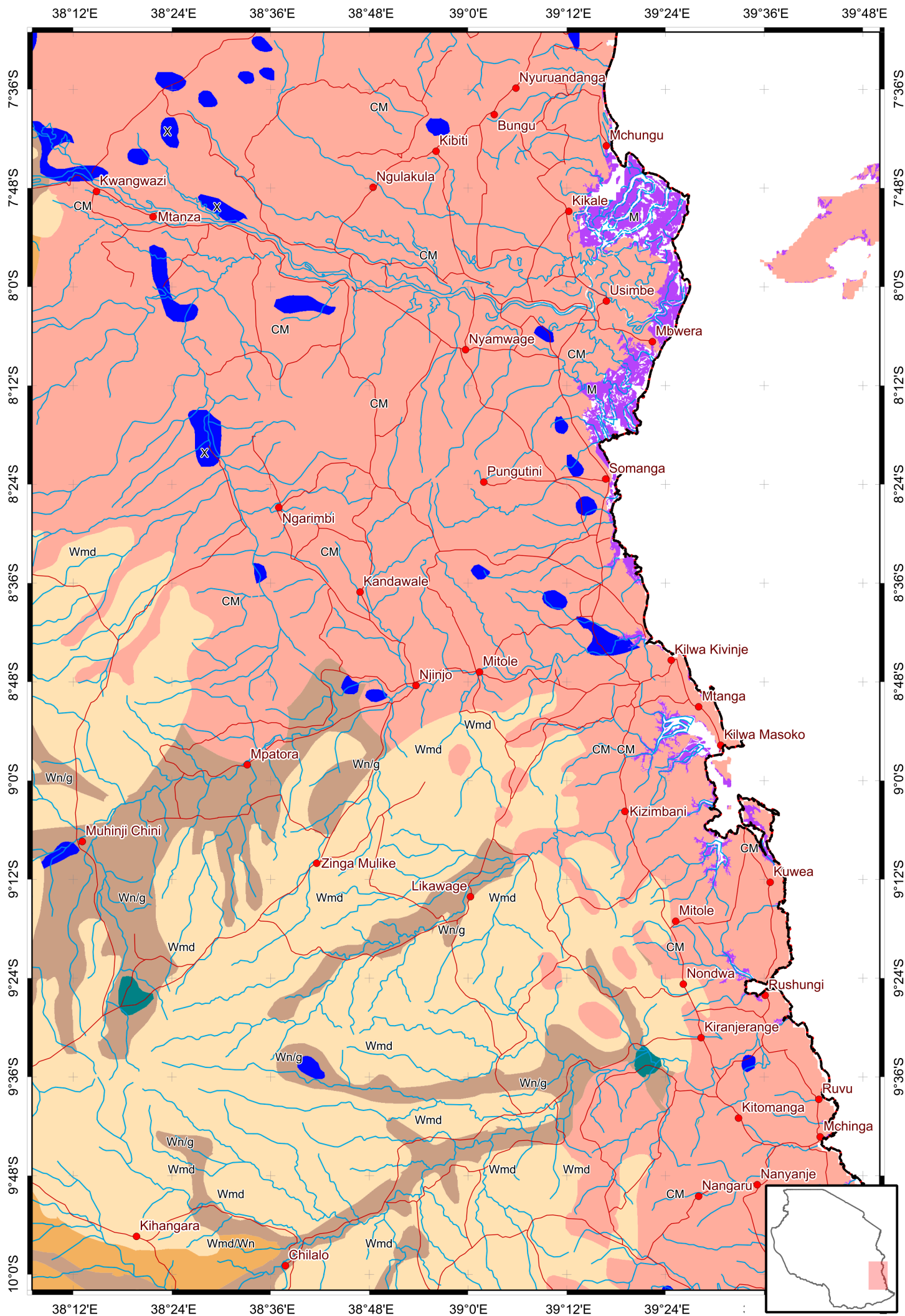


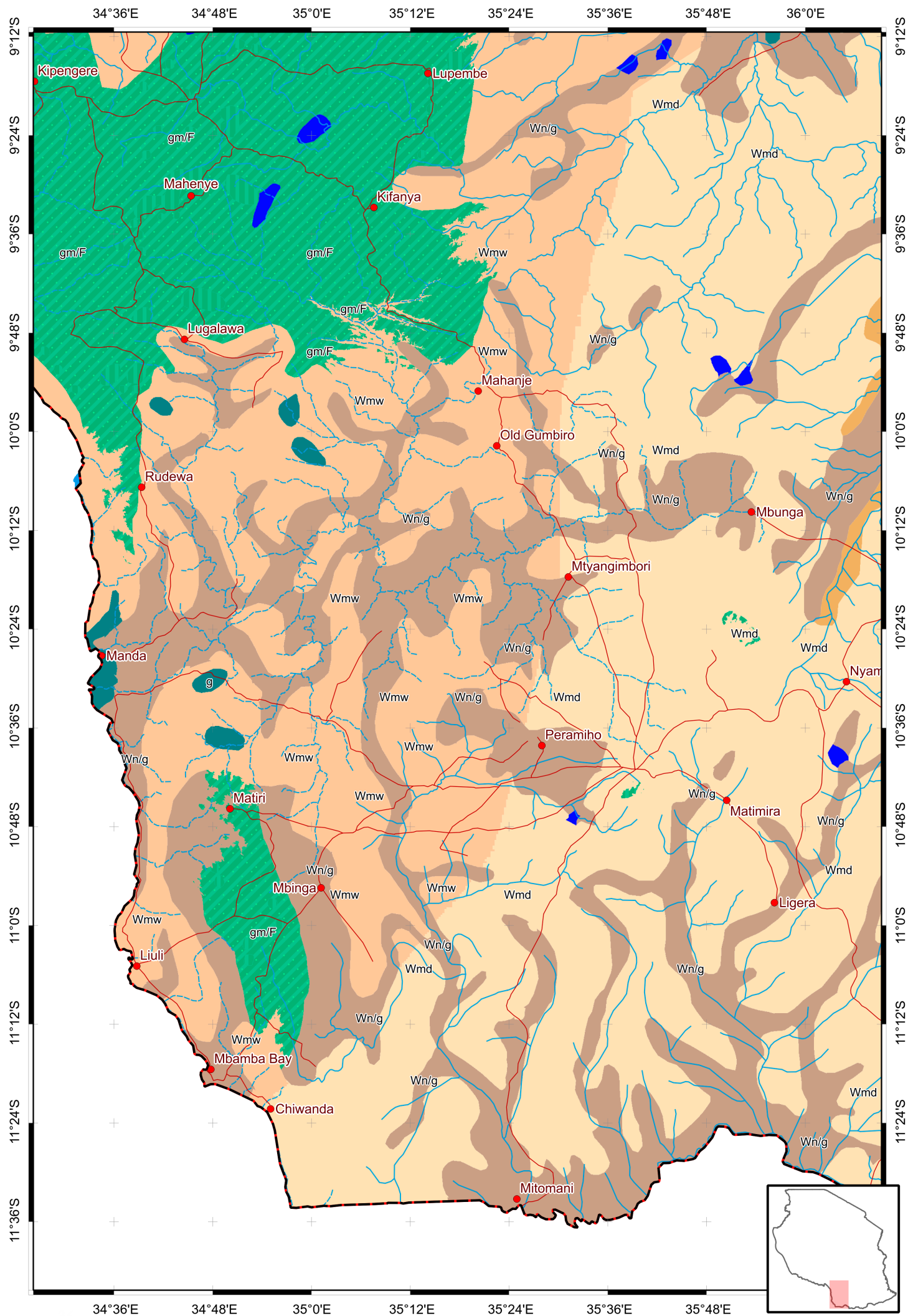


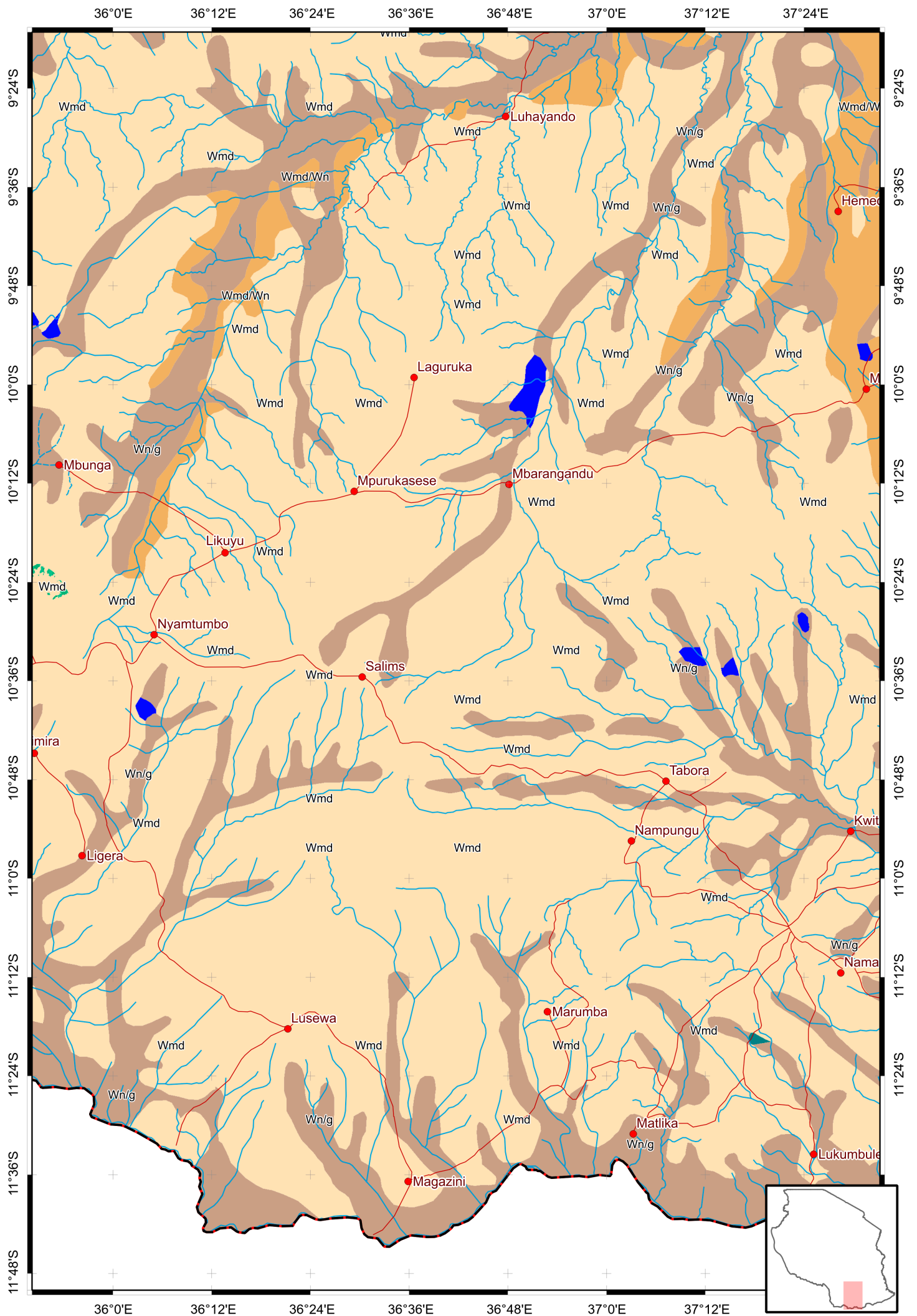




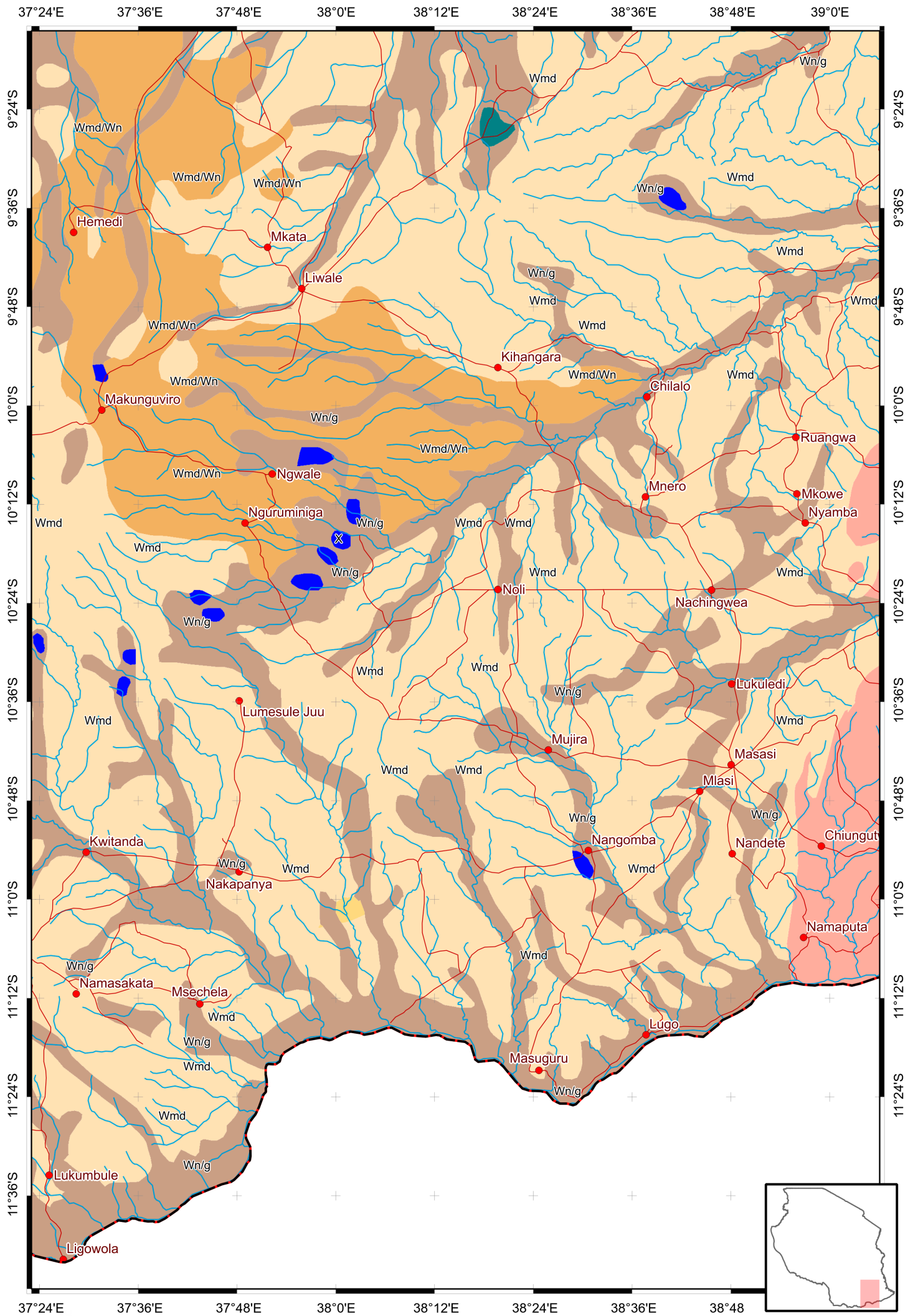




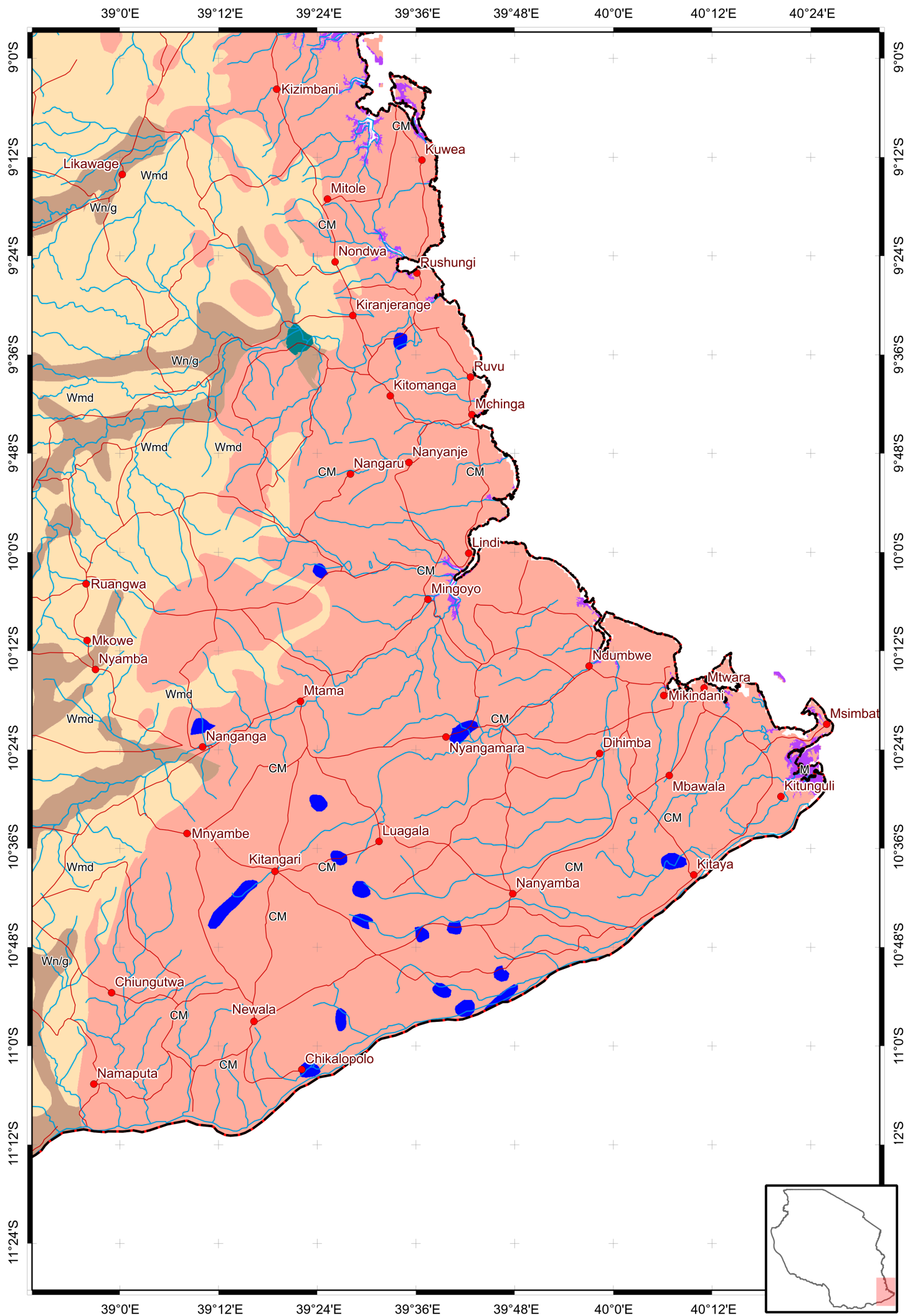














## 5. Description and species list for Tanzania

### 5.1. Methodology

For each of the vegetation types, we obtained information on species assemblages (those tree species expected to occur in a particular vegetation type) based on information that was provided in the national references (details are provided in Volumes 2 to 5). For each of the countries where we had information on the national “manifestation” of a vegetation type (for example, Afromontane rain forest as it was described for Ethiopia by Friis et al. 2010), we created a separate column within which we gave an indication that a particular tree species was expected to occur within that vegetation type and within that country.

Where species were not listed in the national reference for a focal country, we checked with information on national lists of all the tree species that occur in the focal country whether the species could **potentially** occur in the focal vegetation type and focal country **because the species was documented to occur in the same vegetation type in other countries**. For example, the species *Cyathea dregei* was documented to occur in Afromontane rain forest in Malawi, Rwanda and Zambia. From the UNEP-WCMC species database, there was information that this species also occurs in Ethiopia. This led us to indicate that there was information that the species potentially occurred in Afromontane rain forest in Ethiopia (we used the coding of “f” in the species assemblage table to indicate this). **Note that it is possible that species indicated with “f” for a particular country and forest type do NOT occur in that particular country and forest type in reality (meaning that, in reality, differences exist between species assemblages of the same forest type between countries – or possibly indicating errors in the obtained species assemblage for a particular country).**

After compiling information on species assemblages, we selected a subset of species to feature in species composition tables. These were mainly “useful tree species”, which are tree, bushland or liana species that were listed in at least one of the references that we consulted on tree species that are expected to be useful to farming or pastoral communities in the VECEA countries

Information that is provided in species composition tables was simplified from the information provided in Volumes 2 to 5, providing the following types of information:

- “x” in a species composition tables indicates that the species is expected to occur in the vegetation type based on references that we consulted or field experience from a national collaborator
- “C” in a species composition table indicates that the species is a characteristic species for the vegetation type (see Volumes 2 to 5 for details)

- “f” in a species composition table indicates that the species was not initially listed for the country, but could potentially occur because the species is known to occur in that particular country
- A “characteristic species” is a species that was listed for the focal vegetation type in a regional description of potential natural vegetation (this regional description was typically White 1983)
- A species that is “not characteristic” is a species that was not listed for the focal vegetation type in a regional description of potential natural vegetation
- An “indicator species” was defined as a characteristic species that was only listed once (i.e. for the focal vegetation type) among all the vegetation types of the same physiognomic classification and the same floristic region. For example, *Chrysophyllum gorungosanum* is an indicator species for Afromontane rain forest since this species was only listed for Afromontane rain forest (White 1983 p. 164) among all the forests described for the Afromontane floristic region.

Another modification from the species composition tables that were given in Volumes 2 to 5 is that we excluded species that were listed to be present (coding “x” or “C”) in fewer than 50 percent of all the countries in which the vegetation type occurs. We implemented this change to increase consensus among national manifestations of the focal vegetation type (and especially to filter out marginal occurrence of a species), and also to increase confidence about the regional occurrence of a species. Although this approach has led to better agreements between national documentation, we may have excluded some species that widely occur in some situations (please compare the abbreviated lists provided here with the more comprehensive lists provided in Volumes 2 to 5 if you are particularly interested in these species).

## 6. Afromontane rain forest (Fa)

### 6.1. Description

Afromontane rain forest is very similar in structure (physiognomy) to certain types of Guineo-Congolian rain forest. Species composition, however, is almost entirely different (many tree genera have different species in Afromontane rain forest and Guineo-Congolian rain forest, on the other hand). Other physiognomic and floristic differentiation between Afromontane rain forest and Guineo-Congolian rain forest include the greater degree of bud protection, a lesser degree of drip tips of leaves development, the occurrence of tree ferns (*Cyathea*) and the occurrence of conifers (*Podocarpus*; especially *Podocarpus latifolius* as *Podocarpus falcatus* (synonym: *P. gracilior*) are more characteristic of Afromontane undifferentiated forest; White 1983 p. 164 - 165).

These forests occur mainly between 1200 and 2500 m on the slopes of certain mountains. However, the altitudinal limits vary greatly according to distance from the equator, proximity to the ocean, and size and configuration of the massif on which these forests occur (White 1983 p. 164). The observation that vegetation belts are scaled according to the size of the mountain on which they occur were first observed in the Alps, where this phenomenon is described as the 'Massenerhebung effect' (mass-elevation effect). The mean annual rainfall lies mostly between 1250 and 2500 mm. Mists that frequently occur during the dry season of one to five months may explain the fact that Afromontane rain forest is much less deciduous than lowland semi-evergreen forests that receive similar rainfall. Only a few of the larger tree species (*Entandrophragma excelsum* and *Pouteria adolfi-friedericii*) lose their leaves - and then only for a few days (White 1983 p. 164).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Afromontane rain forest and no other Afromontane forest types) that were listed as characteristic species for one or several national maps include ***Chrysophyllum gorungosanum*, *Cola greenwayi*, *Cylicomorpha parviflora*, *Entandrophragma excelsum*, *Ficalhoa laurifolia*, *Hallea rubrostipulata*, *Myrianthus holstii*, *Ochna holstii*, *Ocotea usambarensis*, *Olea capensis*, *Parinari excelsa*, *Pouteria adolfi-friedericii*, *Strombosia scheffleri*, *Syzygium guineense* subsp. *afromontanum* and *Tabernaemontana stapfiana*.**





Figure 6.1. View of canopy from Afromontane rain forest (synonym: moist evergreen Afromontane forest) north of Masha (Ethiopia). Altitude approximately 1950 m. Photograph by I. Friis and Sebsebe Demissew (September 2002). Reproduced from *Biologiske Skrifter of the Royal Danish Academy of Sciences and letters*, Vol. 58, Fig 25A. 2010.



Figure 6.2. Afromontane rain forest in Nyungwe National Park (Rwanda). Photograph by C. K. Ruffo (June 2008).



Figure 6.3. *Cyathea manniana* tree ferns in Lake Victoria transitional rain forest (Ff). The presence of tree ferns (*Cyathea* species) is typical for Afromontane rain forest (White 1983 p. 164). However, this species also occurs in other types of forests with admixture of Afromontane species. Photograph by F. Gachathi (2009).



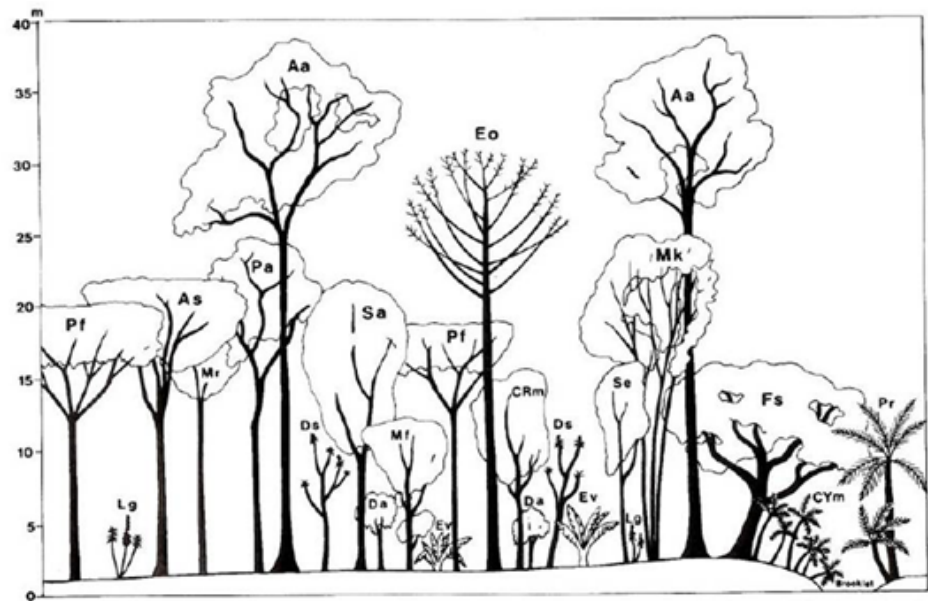


Figure 6.4. Transect of Primary or mature secondary moist evergreen Afromontane forest (classified in VECEA as Afromontane rain forest [Fa]). Generalised representation based on observations made in old secondary forest at approximately 1700 metres altitude south of Gore, IL floristic region. Although this locality is situated just below the altitudinal limit used for mapping (6) Moist evergreen Afromontane forest (Fa) no species restricted to (7) Transitional rain forest (mapped in VECEA as Afromontane moist transitional forest [Fe]) were observed, but a few species, for example *Hallea rubrostipulata*, are known from both vegetation types. The abbreviated names for the species stand for: Aa: *Pouteria (Aningeria) adolfi-friederici*. As: *Albizia schimperiana*. CRm: *Croton macrostachyus*. CYm: *Cyathea manniana*. Da: *Dracaena afromontana*. Ds: *Dracaena steudneri*. Eo: *Euphorbia ampliphylla*. Ev: *Enset ventricosum*. Fs: *Ficus sur*. Lg: *Lobelia giberroa*. Mf: *Millettia ferruginea*. Mk: *Macaranga capensis* var. *kilimandscharica*. Mr: *Hallea (Mitragyna) rubrostipulata*. Pa: *Prunus africana*. Pf: *Polyscias fulva*. Pr: *Phoenix reclinata*. Sa: *Schefflera abyssinica*. Sa: *Sapium ellipticum*. Drawn by Victoria C. Friis. Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 24. 2010.

## 6.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 6. Species composition of Afromontane rain forest (Fa)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania (FarT subtype)	Tanzania (FawT subtype)	Uganda	Zambia
<i>Chrysophyllum gorungosanum</i>	indicator species		C	C	x	x	f	C	f
<i>Cola greenwayi</i>	indicator species		C	C		x	f		C
<i>Cylicomorpha parviflora</i>	indicator species		C	x		f	f		
<i>Entandrophragma excelsum</i>	indicator species			C	C	f	f	C	f
<i>Ficalhoa laurifolia</i>	indicator species			C	C	x	C	C	f
<i>Hallea rubrostipulata</i>	indicator species	C	x	x		x	f	f	
<i>Myrianthus holstii</i>	indicator species		x	x	x	x	f	f	f
<i>Ochna holstii</i>	indicator species	x	C	x	x	x	C	f	f
<i>Ocotea usambarensis</i>	indicator species		C	C	C	x	C	C	f
<i>Olea capensis</i>	indicator species	C	C	C	C	f	C	C	f
<i>Parinari excelsa</i>	indicator species			C	C	x	f	f	C
<i>Pouteria adolfi-friedericii</i>	indicator species	C	C	C	x	C	C	C	C
<i>Strombosia scheffleri</i>	indicator species		C	C	C	x	f	C	
<i>Syzygium guineense</i>	indicator species ( <i>Syzygium guineense</i> ssp. <i>afromontanum</i> )	C	C	x	C	x	f	x	f
<i>Tabernaemontana stapfiana</i>	indicator species		C	x	x	f	f	x	
<i>Diospyros abyssinica</i>	characteristic species	x	C	x	f	f	f	f	f
<i>Podocarpus latifolius</i>	characteristic species (conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest)		C	C	C	f	C	C	C
<i>Prunus africana</i>	characteristic species	C	C	C	C	f	x	C	f
<i>Xymalos monospora</i>	characteristic species		C	x	C	x	C	x	f
<i>Acacia abyssinica</i>	invasive species	x	C	x	f	f	f	f	
<i>Acacia lahai</i>	invasive species	f	x			f	f	f	
<i>Agauria salicifolia</i>		f	x	x	x	f	x	f	C
<i>Albizia grandibracteata</i>		C	x		f	f	f	f	
<i>Albizia gummifera</i>	not characteristic	C	C	C	f	x	f	C	f
<i>Albizia schimperiana</i>		C	f	C		f	f	C	f
<i>Alchornea hirtella</i>			x	x	x	f	f	f	f
<i>Allophylus abyssinicus</i>		x	C	x	x	f	f	x	f
<i>Allophylus africanus</i>		f	C	f	f	f	f	f	f
<i>Anthocleista grandiflora</i>			C	x		x	f	x	
<i>Apodytes dimidiata</i>	not characteristic	x	C	C	x	f	f	f	f
<i>Balthasaria schliebenii</i>							C		
<i>Berberis holstii</i>		f	x	x		f	f	f	
<i>Bersama abyssinica</i>		x	C	x	x	x	x	C	f
<i>Blighia unijugata</i>		x	x	f	f	f	f	f	f
<i>Bridelia brideliifolia</i>				x	C	f	C	f	
<i>Carapa procera</i>					C	f	f	f	
<i>Casearia battiscombei</i>			C	x		f	f	f	
<i>Cassipourea malosana</i>	not characteristic	C	C	C		f	C	x	f
<i>Cassipourea ruwensoriensis</i>		f	f		C	f	f	f	
<i>Catha edulis</i>		f	C	x	f	f	f	f	f
<i>Celtis africana</i>		C	C	C	f	f	f	f	f
<i>Celtis gomphophylla</i>		f	x	x	f	f	f	f	f
<i>Clausena anisata</i>		x	x	x	x	f	f	x	f
<i>Cordia africana</i>		x	x	f	f	f	f	f	f
<i>Cornus volkensii</i>			C	C	x	x	f	f	
<i>Croton macrostachyus</i>		C	C	C	x	f	f	x	f
<i>Croton megalocarpus</i>	not characteristic		f	x	x	f	f	f	f
<i>Croton sylvaticus</i>		f	C	x		f	f	f	f
<i>Cussonia spicata</i>			x	C		f	f	x	f
<i>Cyathea dregei</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest	f	f	x	x	f	f		f
<i>Cyathea humilis</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest		x			f	f		
<i>Cyathea manniana</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest	x	x	x	x	f	f	C	
<i>Discopodium penninervium</i>		f	x	x	x	f	f	f	
<i>Dodonaea viscosa</i>		f	f	x	x	f	f	f	f
<i>Dombeya torrida</i>		x	C	x	x	f	C	x	
<i>Dovyalis abyssinica</i>		f	x	x		f	f	f	f
<i>Dovyalis macrocalyx</i>			x	x	x	f	f	f	f
<i>Dracaena fragrans</i>		x	f	x	f	f	f	f	
<i>Dracaena steudneri</i>		x	C	x	x	f	f	x	f
<i>Ehretia cymosa</i>		x	C	x	x		f		
<i>Ekebergia capensis</i>		C	C	C	x	f	f	x	f
<i>Elaeodendron buchananii</i>		x	f	x	f	f	f	f	f
<i>Embelia schimperi</i>		f	x	x	x	f	f	f	f
<i>Ensete ventricosum</i>		x	f	x	x	f	f	f	f
<i>Eugenia capensis</i>		x	f	x	x	f	f	f	f
<i>Euphorbia abyssinica</i>		f	C	x		f	f	x	f
<i>Fagaropsis angolensis</i>	not characteristic	x	f	x	x	f	f	f	f
<i>Ficus exasperata</i>		f	x	f	x	f	f	f	f
<i>Ficus natalensis</i>			x	x	x	f	f	f	f
<i>Ficus ovata</i>		C	f	x	f	f	f	f	f
<i>Ficus sur</i>		C	C	x	f	f	f	f	f



SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania (FarT subtype)	Tanzania (FawT subtype)	Uganda	Zambia
<i>Ficus thonningii</i>		C	C	C	f	f	f	f	f
<i>Galiniera saxifraga</i>		x	C	x	C	f	f	C	
<i>Garcinia buchananii</i>		x	x	f	f	f	f	x	f
<i>Hagenia abyssinica</i>		f	C	C	C	f	f	f	f
<i>Harungana madagascariensis</i>			C	f	f	f	f	f	f
<i>Hypericum revolutum</i>		f	f	x	x	f	f	f	f
<i>Ilex mitis</i>	not characteristic	C	x	C	x	f	C	x	f
<i>Kigelia moosa</i>			C			f	f	f	
<i>Landolphia buchananii</i>		x	f	x		f	f	f	f
<i>Lepidotrichilia volkensii</i>		x	C	x	x	f	f	C	f
<i>Macaranga capensis</i>		f	C	C	C	x	C	C	f
<i>Maesa lanceolata</i>		x	C	f	x	f	C	x	C
<i>Manilkara butugii</i>		x	x					f	
<i>Maytenus acuminata</i>			C	C	x	f	C	x	f
<i>Maytenus undata</i>		x	x	x	x	f	f	f	f
<i>Milicia excelsa</i>		f	x	x	f	f	f	f	
<i>Millettia dura</i>			x	x	f	f	f	f	
<i>Neoboutonia macrocalyx</i>			C	C	C	x	f	x	f
<i>Newtonia buchananii</i>	not characteristic		x	f	x	x	f	f	f
<i>Nuxia congesta</i>	not characteristic	x	C	x	x	f	C	f	f
<i>Nuxia floribunda</i>	not characteristic		f	x	x	f	f	f	f
<i>Ocotea kenyensis</i>	not characteristic	C	C	x	x	f	x	f	
<i>Olea europaea</i>	not characteristic	f	C	x	f	f	f	f	f
<i>Olinia rochetiana</i>		f	f	x	x	f	x	f	f
<i>Peddiea fischeri</i>			x		x	f	f	f	f
<i>Phoenix reclinata</i>	palm species	x	x	x	f	f	f	f	f
<i>Phytolacca dodecandra</i>		f	x	x	f	f	f	f	f
<i>Pittosporum viridiflorum</i>		x	x	x	x	f	x	C	f
<i>Pleiocarpa pycnantha</i>			x		x	f	f	f	f
<i>Podocarpus falcatus</i>	not characteristic	x	x	x	C	C	f	f	
<i>Podocarpus henkelii</i>	conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest; species that is very localized north of the Limpopo river			C					
<i>Podocarpus usambarensis</i>	conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest		x			f	f	f	
<i>Polyscias fulva</i>		C	f	C	C	x	f	x	f
<i>Pouteria altissima</i>		f	f		f	f	f	f	C
<i>Psychotria mahonii</i>			C	x	x	f	x	C	f
<i>Psydrax parviflora</i>		f	C	x	x	f	f	f	f
<i>Pterolobium stellatum</i>		f	x	x	f	f	f	f	f
<i>Rapanea melanophloeos</i>	not characteristic	f	C	C	x	f	C	x	f
<i>Rauvolfia caffra</i>			f	x		x	f	f	f
<i>Rhamnus prinoides</i>		x	x	x	x	f	f	x	f
<i>Rinorea angustifolia</i>			x		x	f	f	f	
<i>Ritchiea albersii</i>		x	x		x	f	f	f	f
<i>Rothmannia urcelliformis</i>		x	f	x		f	f	f	f
<i>Rubus apetalus</i>		f	x	x	x	f	f	f	f
<i>Sambucus ebulus</i>			x			f	f	f	
<i>Schefflera abyssinica</i>		C	C	C		f	f	x	f
<i>Schefflera volkensii</i>		x	C			f	f	C	
<i>Scutia myrtina</i>		f	x	x	f	f	f	f	f
<i>Shirakiopsis elliptica</i>		C	x	x	x	f	f	f	f
<i>Sinarundinaria alpina</i>	Afromontane bamboo	C	f	x	x	f	f	x	
<i>Smilax anceps</i>		x	x		x	f	f	f	f
<i>Solanecio mannii</i>		x	f	x	f	f	f	f	f
<i>Solanum aculeastrum</i>			x	x	x	f	f	f	x
<i>Symphonia globulifera</i>					C	f	C	C	f
<i>Synsepalum brevipes</i>			C	f		f	f	f	f
<i>Syzygium cordatum</i>							C		f
<i>Tabernaemontana pachysiphon</i>			C	f		f	f	f	f
<i>Trema orientalis</i>		x	x	f	x	f	f	f	f
<i>Trichilia dregeana</i>		x	x	f		f	f	f	f
<i>Vangueria apiculata</i>		f	f	x	x	f	f	f	f
<i>Vepris nobilis</i>		x	C	x	x	f	f	f	f
<i>Vernonia auriculifera</i>		x	x		x	f	f	f	
<i>Vernonia myriantha</i>		x	x	x	x	f	f	f	f
<i>Vitex keniensis</i>			C						
<i>Zanthoxylum gillettii</i>		f	C		x	f	f	f	

## 7. Afromontane undifferentiated forest (Fbu) and Afromontane single-dominant *Juniperus procera* forest (Fbj)

### 7.1. Description

Afromontane undifferentiated forest is usually shorter than Afromontane rain forest (Fa). Although there is some floristic overlap in species composition between these two forest types (for example, *Podocarpus latifolius*, *Prunus africana* and *Xymalos monospora* were listed as characteristic species both for Afromontane rain forest and Afromontane undifferentiated forest), species composition is distinctive (White 1983 p. 165). White (1983) reserved the term of “undifferentiated forests” to forests that undergo rapid and kaleidoscopic changes in structure and species composition over short distances (White 1983 p. 47).

Afromontane undifferentiated forest usually replaces Afromontane rain forest at comparable altitudes (usually between 1250 and 2500 m) on the drier slopes of mountains and at higher altitudes on the wetter slopes, and sometimes at lower altitudes. Afromontane undifferentiated forest usually receives lower rainfall (possibly as low as 850 mm, which is the upper rainfall limit of East African evergreen bushland [Be]) than Afromontane rain forest (White 1983 p. 165).

After fire, Afromontane undifferentiated forests are sometimes replaced by almost pure stands of Afromontane single-dominant *Juniperus procera* forest (Fbj), Afromontane single-dominant *Widdringtonia whytei* forest (Fc) or Afromontane single-dominant *Hagenia abyssinica* forest (Fd). Within the VE-CEA map, we mapped the latter two types of forests (Fc and Fd) separately but mapped Afromontane undifferentiated forest together with Afromontane single-dominant *Juniperus procera* forest (Fbj). We made this decision especially since most of the national maps only listed one of these two forests types, whereas our floristic and environmental analysis suggested that both these forests belonged to the same potential natural vegetation type.

Afromontane single-dominant *Juniperus procera* forest (Fbj) mostly occurs on the drier slopes of mountains between 1800 and 2900 m, although it sometimes descends to 1000 m. Annual rainfall is usually between 1000 and 1150 mm, but sometimes more than 1250 mm. *Juniperus procera* also occurs outside forests as in evergreen bushland (Be, see volume 5) where rainfall can be as low as 650 mm - this could be the original habitat of this species (for example, the species occurs in evergreen bushland [Be] at lower elevations on Mt. Kulal [Kenya] where it is 4 to 6 m tall [White 1983 p. 121]). *Juniperus procera* is a strong light-demander that does not regenerate in its own shade, so its presence as forest tree depends on fire. This species also seems to be intolerant of deep humus layers (White 1983 p. 165 - 166).

Besides the **potentially** dominant *Juniperus procera*, regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Afromontane undifferentiated forest and no other Afromontane forest types) that were listed as characteristic species for one or several national maps include *Halleria lucida*, *Ilex mitis*, *Kiggelaria africana* (this species does not extend as far north as Ethiopia), *Nuxia congesta*, *Nuxia floribunda* (this species does not extend as far north as Ethiopia), *Ocotea kenyensis*, *Podocarpus falcatus* (synonym: *Podocarpus gracilior*) and *Rapanea melanophloeos*.

Figure 7.1. Afromontane undifferentiated forest with canopy of *Juniperus procera* and *Podocarpus falcatus* in Chilimo forest (Ethiopia). Altitude approximately 2550 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 20A. 2010.



Figure 7.2. Afromontane single-dominant *Juniperus procera* forest with a tree of *Hagenia abyssinica* in the foreground near the upper edge of Chilimo forest (Ethiopia). Altitude approximately 3000 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 21B. 2010.







Figure 7.3. Climax stand of *Juniperus procera* (30 - 37 m) in Afromontane single-dominant *Juniperus procera* forest. Photographed in 1960 by unknown photographer at unknown location (presumably in Kenya). Photograph given to F. Gachachi by C.G. Trapnell (before his decease).



Figure 7.4. Afromontane single-dominant *Juniperus procera* forest in Maralal District (Kenya, top, photograph taken in 2009) and Mt. Kenya (bottom, photograph taken in 2011). Photographs by F. Gachathi.





Figure 7.5. A glade in Afromontane undifferentiated forest (synonym: montane sclerophyll forest) with *Juniperus procera* on the right and an unidentified *Podocarpus* species on the left. Afromontane bamboo (*Sinarundinaria alpina*, synonym: *Arundinaria alpina*) is portrayed behind the unidentified *Podocarpus* species. Western slopes of Mt. Kenya along the Sirimon track. Shell guide to East African birds (reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).

## 7.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 7. Species composition of Afromontane undifferentiated forest (Fbu) and Afromontane single-dominant *Juniperus procera* forest (Fb)

SPECIES	Regional status	Ethiopia (Fbu subtype)	Ethiopia (Fb subtype)	Kenya	Malawi	Tanzania	Uganda	Zambia
<i>Juniperus procera</i>	dominant in single-dominant <i>Juniperus procera</i> forest	C	D	C	D	C	C	
<i>Halleria lucida</i>	indicator species	x	x	x	x	C	f	f
<i>Ilex mitis</i>	indicator species	x	f	C	C	x	C	f
<i>Kiggelaria africana</i>	indicator species (species does not extend as far north as Ethiopia)				x	f		
<i>Nuxia congesta</i>	indicator species	x	C	C	C	C	x	C
<i>Nuxia floribunda</i>	indicator species (species does not extend as far north as Ethiopia)			f	x	x	x	C
<i>Ocotea kenyensis</i>	indicator species	f	f	f	f	f	f	
<i>Podocarpus falcatus</i>	indicator species (conifer species that is absent from Guineo-Congolian rain forest and less characteristic of Afromontane rain forest)	C	f	C	f	f	C	
<i>Rapanea melanophloeos</i>	indicator species	x	C	C	C	C	x	C
<i>Apodytes dimidiata</i>	characteristic species	C	f	C	x	C	f	f
<i>Podocarpus latifolius</i>	characteristic species (conifer species that is absent from Guineo-Congolian rain forest and less characteristic of Afromontane rain forest; species does not extend as far north as Ethiopia)			C	C	f	x	f
<i>Prunus africana</i>	characteristic species	C	f	C	C	C	x	f
<i>Xymalos monospora</i>	characteristic species (species that does not extend as far north as Ethiopia)			x	C	f	f	f
<i>Acacia abyssinica</i>	invasive species	f	f	C	f	f	x	
<i>Acacia lahai</i>	invasive species	f	f	C		f	f	
<i>Acokanthera schimperi</i>		f	C	f		f	f	
<i>Agauria salicifolia</i>		x	f	x	x	C	f	f
<i>Albizia gummifera</i>	not characteristic	x	f	C	f	C	x	f
<i>Allophylus abyssinicus</i>		C	f	x	f	f	x	f
<i>Berberis holstii</i>		f	f	x	x	f	C	
<i>Bersama abyssinica</i>		C	x	C	x	C	x	f
<i>Blighia unijugata</i>		f	f	x	f	f	x	f
<i>Buddleja polystachya</i>		f	C	x		f	f	
<i>Carissa spinarum</i>		x	C	f	f	f	f	f
<i>Cassipourea malosana</i>	not characteristic	C	f	C	C	C	x	f
<i>Catha edulis</i>		f	f	f	f	C	C	f
<i>Celtis africana</i>		C	f	C	x	f	x	f
<i>Clausena anisata</i>		x	C	x	x	f	x	f
<i>Clerodendrum myricoides</i>		x	C	f		f	f	
<i>Cordia africana</i>		x	f	f	f	f	x	f
<i>Cornus volkensii</i>				C	f	f	f	
<i>Croton macrostachyus</i>		C	f	C	f	C	x	f
<i>Croton megalocarpus</i>	not characteristic			f	f	x	x	f
<i>Cussonia holstii</i>		x	f	C		x	x	
<i>Cussonia spicata</i>				C	C	C	x	f
<i>Diospyros abyssinica</i>	not characteristic	x	f	C	f	x	x	f
<i>Discopodium penninervium</i>		x	C	f	f	f	x	
<i>Dodonaea viscosa</i>		x	C	C	f	f	x	f
<i>Dombeya torrida</i>		x	f	C	x	x	x	
<i>Dovyalis abyssinica</i>		C	x	C	f	f	x	f
<i>Dovyalis macrocalyx</i>				x	x	f	x	f
<i>Dracaena steudneri</i>		C	f	C	f	f	x	f
<i>Ehretia cymosa</i>		x	C	C	f		f	
<i>Ekebergia capensis</i>		C	x	C	x	C	C	f
<i>Erica arborea</i>		x	C	f		f	x	
<i>Erythrina abyssinica</i>		f	f	f	f	C	x	f
<i>Erythrina brucei</i>		C	f					
<i>Euclea divinorum</i>	not characteristic	x	x	C	x	C	C	f
<i>Euclea racemosa</i>		f	C	f	f	f	x	f
<i>Euphorbia abyssinica</i>		f	C	C	f	f	f	f
<i>Euphorbia tirucalli</i>		f	C	f	f	f	f	f
<i>Fagaropsis angolensis</i>	not characteristic	x	f	f	f	x	x	f
<i>Faurea saligna</i>				C	f	x	x	f
<i>Ficus ovata</i>		C	f	f	f	f	f	f
<i>Ficus sur</i>		C	f	C	f	f	x	f
<i>Ficus thonningii</i>		C	f	C	x	f	x	f
<i>Galiniera saxifraga</i>		x	C	C	f	f	f	
<i>Grewia ferruginea</i>		x	C					
<i>Hagenia abyssinica</i>		x	x	C	x	C	f	f
<i>Hypericum revolutum</i>		x	f	C	f	f	x	f
<i>Hypericum roeperanum</i>		x	x	f		f	x	f
<i>Lannea fulva</i>				f		f	x	



SPECIES	Regional status	Ethiopia (FbuE subtype)	Ethiopia (FbjE subtype)	Kenya	Malawi	Tanzania	Uganda	Zambia
<i>Lepidotrichilia volkensii</i>		C	f	C	x	f	f	f
<i>Maesa lanceolata</i>		x	C	f	x	x	x	f
<i>Margaritaria discoidea</i>		x	f	f	f	C	x	f
<i>Maytenus acuminata</i>				f	x	x	f	f
<i>Maytenus undata</i>		C	x	C	f	f	C	f
<i>Mimusops kummel</i>		x	f	f	f	f	x	
<i>Morella salicifolia</i>		x	f					
<i>Myrsine africana</i>		x	f	x	x	f	x	f
<i>Olea capensis</i>	not characteristic	x	f	C	C	C	x	f
<i>Olea europaea</i>	not characteristic	C	C	C	x	f	C	f
<i>Olinia rochetiana</i>		C	f	C	C	C	C	C
<i>Osyris lanceolata</i>		x	f	f		f	x	
<i>Parinari excelsa</i>	not characteristic				f	C	f	f
<i>Phoenix reclinata</i>	palm species	f	f	x	f	x	f	f
<i>Phytolacca dodecandra</i>		x	f	x	f	f	x	f
<i>Pittosporum viridiflorum</i>		x	f	C	C	x	x	f
<i>Psydrax schimperiana</i>		f	f	x	f	f	x	f
<i>Pterolobium stellatum</i>		f	C	x	f	f	f	f
<i>Rhamnus prinoides</i>		x	C	x	x	f	x	f
<i>Rhoicissus tridentata</i>		f	C	f	x	f	f	f
<i>Rhus longipes</i>		f	f	f	x	f	x	f
<i>Rhus natalensis</i>		f	C	x	f	f	x	f
<i>Rhus vulgaris</i>		f	f	x	f	f	x	f
<i>Ritchiea albersii</i>		x	f	C		x	x	f
<i>Rosa abyssinica</i>		x	C					
<i>Rothmannia urcelliformis</i>		x	f	f	f	f	x	f
<i>Rubus apetalus</i>		x	f	x	f	f	x	f
<i>Rubus volkensii</i>		x	f	x		f	f	
<i>Schefflera abyssinica</i>		x	f	f	x	f	x	f
<i>Schefflera volkensii</i>		x	f	C		f	x	
<i>Schrebera alata</i>	not characteristic	x	C	x	f	C	x	f
<i>Scutia myrtina</i>		x	f	x	f	f	f	f
<i>Senna didymobotrya</i>		f	C	x	f	f	f	f
<i>Shirakiopsis elliptica</i>		f	f	x	f	x	f	f
<i>Sinarundinaria alpina</i>	(Afro-montane bamboo)	x	C	f	x	f	f	
<i>Solanecio mannii</i>		f	f	x	f	f	x	f
<i>Syzygium cordatum</i>				f	x	x	f	f
<i>Syzygium guineense</i>	not characteristic	x	f	C	x	x	x	f
<i>Trema orientalis</i>		x	f	x	f	f	x	f
<i>Vangueria apiculata</i>		x	f	f	f	f	x	f
<i>Vangueria madagascariensis</i>		f	C	f	f	f	x	
<i>Vepris dainellii</i>		C	f					
<i>Vepris nobilis</i>		C	C	C	x	f	C	f
<i>Vernonia amygdalina</i>		x	C	f	f	f	x	f
<i>Vernonia myriantha</i>		f	f	f	x	f	x	f
<i>Zanthoxylum usambarense</i>		f	C	C		x		

## 8. Afromontane single-dominant *Hagenia abyssinica* forest (Fd)

### 8.1. Description

*Hagenia abyssinica* is found on most of the higher mountains between Ethiopia and northern Malawi, including Mt. Kenya, Mt. Meru (Tanzania), the Nyika Plateau (Malawi) and the Virunga mountains (Rwanda). Characteristically, *Hagenia abyssinica* forms almost pure stands of 9 to 15 m tall in a narrow and often interrupted zone between the montane Ericaceous belt (E) and taller types of Afromontane rain forest (Fa) or Afromontane undifferentiated forest (Fbu). The best-developed stands are clearly forest, but other stands have a structure that is better described as woodland or scrub forest (White 1983 p. 166).

Some authors have suggested that Afromontane single-dominant *Hagenia abyssinica* forest is a climax vegetation type where low night temperatures exclude other trees. However, even at high altitudes the dominance of *Hagenia abyssinica* is probably still the result from disturbance. The altitudinal range of this species is between 1800 and 3400 m. The abundance of this species does not seem to be related to moisture conditions, although the species is usually absent from Afromontane rain forest (Fa) and taller types of Afromontane undifferentiated forest (White 1983 p. 166).

Figure 8.1. Afromontane single-dominant *Hagenia abyssinica* forest between the Karisimbi and Bisoke volcanoes in the Volcanoes National Park (Rwanda). Photograph by E. Fischer (October 1991).



Figure 8.2. Flowering *Hagenia abyssinica* tree against a background of Afromontane bamboo (*Sinarundinaria alpina*, synonym: *Arundinaria alpina*) in Kahuzi-Biega National Park (D.R.Congo). *Hagenia abyssinica* is also present in other types of Afromontane forest such as Afromontane single-dominant *Juniperus procera* forest (Fbj). Photograph by E. Fischer (October 1991).



## 8.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 8. Species composition of Afromontane single-dominant *Hagenia abyssinica* forest (Fd)

SPECIES	Regional status	Ethiopia (FbuE subtype)	Kenya	Malawi	Rwanda	Tanzania	Uganda
<i>Hagenia abyssinica</i>	dominant	D	C	D	D	D	C
<i>Hypericum revolutum</i>	indicator species	f	C	f	C	f	x
<i>Apodytes dimidiata</i>	characteristic species	f	f	x	f	f	f
<i>Ilex mitis</i>	characteristic species	f	f	C	f	f	f
<i>Kiggelaria africana</i>	characteristic species (species that does not extend as far north as Ethiopia)			C		f	
<i>Nuxia congesta</i>	characteristic species	f	f	x	f	f	f
<i>Nuxia floribunda</i>	characteristic species		f	x	f	f	f
<i>Podocarpus latifolius</i>	characteristic species (species that does not extend as far north as Ethiopia)		f	C	f	f	f
<i>Prunus africana</i>	characteristic species	f	f	C	f	f	x
<i>Rapanea melanophloeos</i>	characteristic species	f	f	C	f	f	x
<i>Xymalos monospora</i>	characteristic species (species that does not extend as far north as Ethiopia)		f	x	f	f	f
<i>Cassipourea malosana</i>	not characteristic	f	f	C		f	f
<i>Cornus volkensii</i>			C	f	f	f	C
<i>Cussonia spicata</i>			f	C		f	f
<i>Lepidotrichilia volkensii</i>		f	C	x	f	f	f
<i>Olea capensis</i>	not characteristic	f	f	C	f	f	f
<i>Olinia rochetiana</i>		f	f	C	f	f	f
<i>Pittosporum viridiflorum</i>		f	f	C	f	f	f
<i>Schefflera volkensii</i>		f	C			f	f

## 9. Zanzibar-Inhambane transitional rain forest (Fg)

### 9.1. Description

White describes the summits of the transitional rain forests of the East Usambara mountains as a typical example of Zanzibar-Inhambane transitional rain forest. The East Usambara mountains are not high enough for the occurrence of Afromontane rain forest (Fa), but several Afromontane species occur at altitudes that are much lower than their normal limits on other mountains. Other examples of Zanzibar-Inhambane transitional rain forest, although floristically poorer, occur in Malawi (Misuku Hills [1370 m], Machemba Hill, Mt. Nchisi, Lisau Saddle and Chaone Hill) and Zimbabwe (Chirinda forest, White 1983 p. 187).

More than 40 percent of the species are endemic to the East Usambara mountains. Most of these endemic species are floristically related to species that occur in the lowland rain forests of the Guineo-Congolian regional centre of endemism. The pattern that many species are separated by a wide interval with their congeneric species suggests that the East Usambara mountains is a refugium for a flora that was previously distributed over a much larger area. Almost 30 percent the species are either Afromontane or upland ('lower transitional rain forest') species. Most of the remaining species also occur in the Guineo-Congolian regional centre of endemism (White 1983 p. 187). Lovett (1990 p. 292) suggests that in the future, Zanzibar-Inhambane transitional rain forest should be regarded as an Afromontane forest type rather than a Zanzibar-Inhambane forest type since the proportion of Afromontane species is greater.

Regional indicator species (characteristic species listed by White (1983) that were only provided for Zanzibar-Inhambane transitional forest and no other Zanzibar-Inhambane forest types) that were listed as characteristic species for one or several national maps can be further classified into endemic species, Afromontane species, upland species ('lower transitional rain forest') and Guineo-Congolian species (White 1983 p. 187):

- Endemic species include *Anonidium usambarense*, *Cephalosphaera usambarensis* (endemic genus), *Enantia kummeriae*, *Englerodendron usambarense* (endemic genus), *Isolona heinsenii* and *Polyceratocarpus scheffleri*
- Afromontane species include *Alangium chinense* (also a indicator for Lake Victoria transitional rain forest [Ff]), *Allanblackia stuhlmannii*, *Cylicomorpha parviflora* (also an indicator for Afromontane rain forest [Fa]), *Isoberlinia scheffleri*, *Myrianthus holstii* (also a indicator for Afromontane rain forest [Fa]), *Ocotea usambarensis* (also a indicator for Afromontane rain forest [Fa]), *Pouteria adolfi-friedericii* (also an indicator for Afromontane rain forest [Fa]), *Strombosia scheffleri* (also an indicator for Afromontane rain forest [Fa]), *Syzygium sclerophyllum*, *Xymalos monospora* (a characteristic species both of Afromontane rain



forest [Fa] and Afromontane undifferentiated forest [Fbu]) and *Zenkerella capparidacea*.

- Upland species include *Morinda asteroscepa*, *Strychnos mitis* and *Trichilia dregeana*
- Guineo-Congolian species include *Chrysophyllum perpulchrum*, *Cleistanthus polystachyus*, *Ficus sur*, *Funtumia africana*, *Greenwayodendron suaveolens* (an endemic subspecies), *Magnistipula butayi* (an endemic subspecies), *Pterocarpus mildbraedii* (an endemic subspecies), *Rauvolfia caffra*, *Schefflerodendron usambarens*, *Synsepalum cerasiferum*, *Synsepalum msolo* and *Treculia africana*.



Figure 9.1. View from a gap inside Zanzibar-Inhambane transitional rain forest at Mbomole Hill (Amani Nature Reserve, Tanzania). Altitude approximately 970 m. Photograph by H. N. Moshi (2009).

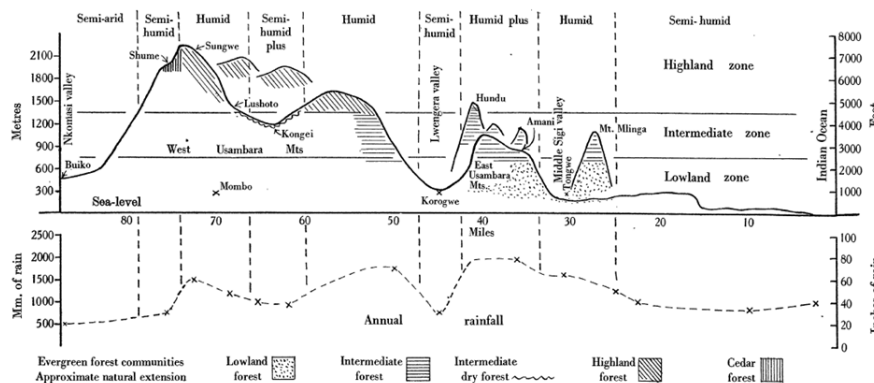


Figure 9.2. Zanzibar-Inhambane transitional rain forest (synonym: intermediate forest) forest occurs at lower altitudes than Afromontane forests (Fa and Fb; the figure gives the synonyms of "highland forest" and "Cedar forest") and at higher altitudes than Zanzibar-Inhambane lowland rain forest (Fo; the figure gives the synonym of "lowland forest"). Moreau (1935, Fig. 1). Figure obtained from URL: <http://www.jstor.org/stable/2256144>

## 9.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).



Table 9. Species composition for Zanzibar-Inhambane transitional rain forest (Fg)

SPECIES	Regional status	Kenya	Tanzania	Uganda (LC1U subtype)	Uganda (LC2U subtype)	Uganda (LC3U subtype)	Uganda (LD1U subtype)	Uganda (LD2U subtype)	Uganda (LD3U subtype)	Uganda (LD4U subtype)
<i>Alstonia boonei</i>	indicator species			f	f	f	C	C	f	C
<i>Antiaris toxicaria</i>	indicator species	f	f	C	C	f	C	x	C	C
<i>Chrysophyllum albidum</i>	indicator species	f		f	C	C	C	x	f	f
<i>Entandrophragma cylindricum</i>	indicator species			f	C	f	f	C	f	f
<i>Entandrophragma utile</i>	indicator species			f	C	f	C	C	f	f
<i>Holoptelea grandis</i>	indicator species			f	x	f	C	C	f	f
<i>Khaya anthotheca</i>	indicator species		f	f	f	f	f	C	f	f
<i>Khaya grandifoliola</i>	indicator species			f	f	f	f	C	f	f
<i>Mildbraediendron excelsum</i>	indicator species			f	f	f	C	C	f	f
<i>Milicia excelsa</i>	indicator species	f	f	f	x	f	f	x	f	C
<i>Morus mesozygia</i>	indicator species	f	f	f	C	f	f	x	f	f
<i>Piptadeniastrum africanum</i>	indicator species			C	C	f	f	x	f	f
<i>Pycnanthus angolensis</i>	indicator species		f	C	C	f	f	x	f	f
<i>Cynometra alexandri</i>	characteristic species		f	f	f	f	f	C	f	f
<i>Entandrophragma angolense</i>	characteristic species	f	f	f	C	f	C	C	f	f
<i>Maesopsis eminii</i>	characteristic species	f	f	C	C	C	C	C	f	f
<i>Pouteria altissima</i>	characteristic species	f	f	f	C	C	f	x	f	f
<i>Albizia coriaria</i>		f	f	f	f	f	C	f	C	C
<i>Albizia glaberrima</i>		f	f	f	C	f	C	x	f	C
<i>Albizia grandibracteata</i>		f	f	f	C	f	C	C	C	C
<i>Albizia gummifera</i>		f	f	f	C	C	f	x	C	f
<i>Albizia zygia</i>		f	f	f	C	f	C	x	f	C
<i>Balanites wilsoniana</i>		f	f	f	x	f	f	C	f	f
<i>Beilschmiedia ugandensis</i>			f	f	x	f	f	x	f	f
<i>Blighia unijugata</i>		f	f	f	x	f	x	x	C	f
<i>Bombax buonopozense</i>				f	f	f	f	C	f	f
<i>Canarium schweinfurthii</i>			f	C	x	f	f	x	f	C
<i>Cassipourea ruwensoriensis</i>		f	f	f	f	x	f	x	f	f
<i>Celtis adolfi-fridericii</i>	characteristic genus			f	f	f	x	C	f	f
<i>Celtis africana</i>	characteristic genus	f	f	f	C	f	C	C	C	C
<i>Celtis gomphophylla</i>	characteristic genus	f	f	f	C	f	C	x	f	f
<i>Celtis mildbraedii</i>	characteristic genus	f	f	f	C	f	C	C	f	f
<i>Celtis philippensis</i>	characteristic genus	f	f	f	C	f	C	x	f	f
<i>Celtis zenkeri</i>	characteristic genus		f	f	C	f	C	C	f	C
<i>Chrysophyllum gorungosanum</i>		f	f	f	f	C	f	f	f	f
<i>Clausena anisata</i>		f	f	f	x	f	x	x	x	x
<i>Croton macrostachyus</i>		f	f	f	x	f	f	x	C	C
<i>Croton megalocarpus</i>		f	f	f	f	C	f	x	f	f
<i>Diospyros abyssinica</i>		f	f	f	x	x	C	x	f	x
<i>Dombeya kirkii</i>		f	f	f	f	x	x	x	f	f
<i>Dracaena fragrans</i>		f	f	x	x	f	x	f	f	f
<i>Entandrophragma excelsum</i>			f	f	x	C	f	f	f	f
<i>Erythrina excelsa</i>		f	f	f	x	f	f	x	f	f
<i>Erythrophleum suaveolens</i>		f	f	f	f	f	C	C	f	f
<i>Fagaropsis angolensis</i>		f	f	f	x	f	f	x	C	C
<i>Ficus mucoso</i>		f	f	f	C	f	f	x	f	f
<i>Flueggea virosa</i>		f	f	f	x	f	f	x	f	x
<i>Funtumia africana</i>		f	f	x	x	x	C	x	f	f
<i>Funtumia elastica</i>				f	f	f	C	x	f	f
<i>Hallea stipulosa</i>				f	x	f	f	x	f	f
<i>Harrisonia abyssinica</i>		f	f	f	f	f	f	x	f	x
<i>Lannea welwitschii</i>		f	f	f	x	f	f	x	f	f
<i>Lovoa swynnertonii</i>		f	f	f	x	C	f	x	f	f
<i>Lovoa trichilioides</i>			f	C	C	f	f	x	f	f
<i>Maesa lanceolata</i>		f	f	f	x	x	f	x	f	f
<i>Manilkara dawei</i>			f	f	x	f	f	x	f	f
<i>Margaritaria discoidea</i>		f	f	f	x	f	f	C	C	C
<i>Markhamia lutea</i>		f	f	f	x	f	x	x	C	C
<i>Mimusops bagshawei</i>		f	f	C	C	f	C	x	f	C
<i>Morinda lucida</i>			f	f	x	f	f	x	f	f
<i>Myrianthus arboreus</i>			f	f	f	f	f	x	f	f
<i>Nauclea diderrichii</i>				f	f	f	f	x	f	f
<i>Newtonia buchananii</i>		f	f	C	f	C	f	x	f	f
<i>Olea capensis</i>		f	f	f	f	C	f	C	C	f

SPECIES	Regional status	Kenya	Tanzania	Uganda (LC1U subtype)	Uganda (LC2U subtype)	Uganda (LC3U subtype)	Uganda (LD1U subtype)	Uganda (LD2U subtype)	Uganda (LD3U subtype)	Uganda (LD4U subtype)
<i>Parinari excelsa</i>			f	f	C	C	f	x	f	f
<i>Pleiocarpa pycnantha</i>		f	f	f	x	x	f	x	f	f
<i>Polyscias fulva</i>		f	f	x	x	x	f	x	C	f
<i>Prunus africana</i>		f	f	f	x	C	f	x	C	C
<i>Pseudospondias microcarpa</i>		f	f	C	x	f	f	x	f	C
<i>Pterolobium stellatum</i>		f	f	f	x	f	x	x	f	f
<i>Pterygota mildbraedii</i>			f	f	f	f	f	C	f	f
<i>Raphia farinifera</i>	(palm species)	f	f	f	x	f	f	x	f	f
<i>Rauvolfia vomitoria</i>			f	f	x	f	f	x	f	f
<i>Schrebera arborea</i>		f		f	f	f	C	C	f	f
<i>Scutia myrtina</i>		f	f	f	f	f	x	x	f	x
<i>Shirakopsis elliptica</i>		f	f	f	x	C	f	x	C	C
<i>Strombosia scheffleri</i>		f	f	f	x	C	f	x	f	f
<i>Strychnos mitis</i>		f	f	f	x	f	C	C	f	f
<i>Symphonia globulifera</i>			f	C	x	C	f	x	f	f
<i>Synsepalum brevipes</i>		f	f	C	x	f	x	x	f	f
<i>Tabernaemontana pachysiphon</i>		f	f	x	x	f	f	x	f	f
<i>Trema orientalis</i>		f	f	f	x	x	f	x	f	f
<i>Trichilia dregeana</i>		f	f	C	x	f	f	C	f	f
<i>Trilepisium madagascariense</i>		f	f	x	x	f	C	x	f	f
<i>Uapaca guineensis</i>	(one of the more important species of Lake Victoria swamp forest)		f	C	f	f	f	f	f	f
<i>Vepris nobilis</i>		f	f	f	x	f	C	x	x	C
<i>Vernonia amygdalina</i>		f	f	f	x	f	f	x	x	f
<i>Vernonia auriculifera</i>		f	f	f	f	f	f	f	x	C
<i>Warburgia ugandensis</i>		f	f	f	f	f	C	x	f	f
<i>Xylopia aethiopica</i>		f	f	x	f	f	f	x	f	f
<i>Zanthoxylum gillettii</i>		f	f	f	x	f	f	x	f	f

## 10. Afromontane dry transitional forest (Fh)

### 10.1. Description

Afromontane dry transitional forest occurs on the drier lower slopes of those East African mountains and uplands which rise from the plains covered with Somalia-Masai bushlands (Bd and Be, volume 4). Afromontane and non-afromontane species occur together within these forests. Only small fragments remain and there is little published information (White 1983 p. 166).

Remnants of Afromontane dry transitional forest occur near Nairobi at altitudes between 1650 and 1800 m and annual rainfall around 800 mm (White 1983 p. 166).

Regional indicator species (characteristic species listed by White (1983) that were only provided for Afromontane dry transitional rain forest and no other Afromontane forest types) that were listed as characteristic species for one or several national maps ('indicators', see section 3.2) include ***Calodendrum capense*** (a species that also occurs as stunted individuals at higher altitudes in evergreen bushland [Be]), ***Cassipourea malosana***, ***Chaetacme aristata***, ***Chrysophyllum viridifolium***, ***Croton megalocarpus***, ***Euclea divinorum***, ***Fagaropsis angolensis***, ***Markhamia lutea***, ***Olea europaea* subsp. *cuspidata***, (synonym: *Olea africana*), ***Schrebera alata*** (a species that also occurs as stunted individuals at higher altitudes in evergreen bushland [Be]), ***Strychnos usambarensis***, ***Suregada procera***, ***Trichocladus ellipticus***, ***Uvariadendron anisatum*** and ***Warburgia ugandensis***. ***Albizia gummifera*** and ***Newtonia buchananii*** were listed as characteristic species that occur near streams. We hypothesize that these can therefore be categorized as indicator species for Afromontane moist transitional forest (FeK).

White (1983 p. 129) also describes rain-fed dry evergreen forest that occurs as relicts within the greater Serengeti region. The main canopy of this forest consists of *Diospyros abyssinica* (also characteristic of Afromontane dry transitional forest near Nairobi), *Drypetes gerrardii* (also characteristic of Afromontane dry transitional forest near Nairobi), *Elaeodendron buchananii*, *Lecaniodiscus fraxinifolius*, ***Suregada procera*** (an indicator for Afromontane dry transitional forest near Nairobi), and *Vepris nobilis* (White mentions that *Vepris* [syn. *Teclea*] species are characteristic of Afromontane dry transitional forest near Nairobi). Less frequent constituents of the main canopy include ***Chaetacme anisata*** (an indicator of Afromontane dry transitional forest near Nairobi), ***Euclea divinorum*** (an indicator of Afromontane dry transitional forest near Nairobi), ***Olea europaea* subsp. *cuspidata*** (synonym: *Olea africana*, an indicator of Afromontane dry transitional forest near Nairobi) and ***Schrebera alata*** (an indicator of Afromontane dry transitional forest near Nairobi). *Capparis erythrocarpos*, *Croton dichogamus* and *Vepris trichocarpa* are the most common species of the understorey. This similarity in species composition and environmental conditions lead us to include this forest into Afromontane dry transitional forests.

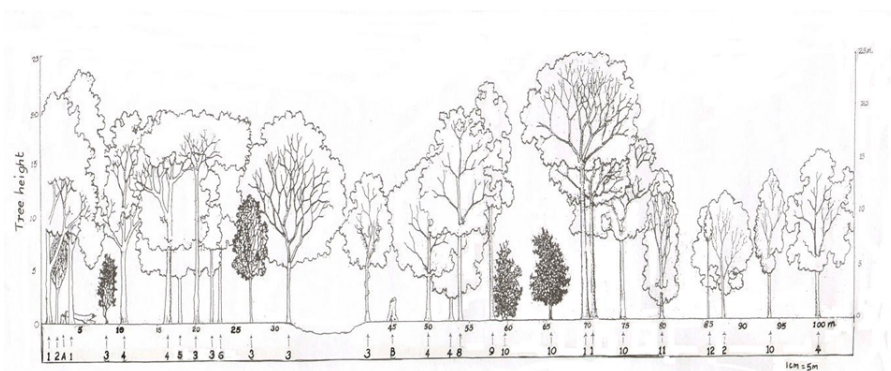


Figure 10.1. Profile diagram of Afromontane dry transitional forest in the Kithoka area north-east of Mt. Kenya (0° 08.065' N; 37° 39.564' E). Altitude 1514 m. This forest was classified by Trapnell *et al.* (1966, 1969, 1976, 1986) as dry intermediate forest. Species shown are: *Calodendrum capense* (4); *Celtis africana* (1); *Croton megalocarpus* (8); *Ehretia cymosa* (11); unidentified *Ficus* sp (9); *Olea europaea* (10, B); *Pittosporum viridiflorum* (3, A); *Ritchiea albersii* (5); *Strychnos henningsii* (12); *Uvariadendron anisatum* (2); *Vepris simplicifolia* (7) and *Vepris trichocarpa* (6). Obtained from Matingi (2011).

## 10.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 10. Species composition of Afromontane dry transitional forest (Fh)

SPECIES	Regional status	Kenya	Tanzania
<i>Albizia gummifera</i>	indicator species (but near streams)	C	C
<i>Calodendrum capense</i>	indicator species	C	f
<i>Cassipourea malosana</i>	indicator species	C	f
<i>Chaetachme aristata</i>	indicator species	x	f
<i>Chrysophyllum viridifolium</i>	indicator species	C	
<i>Croton megalocarpus</i>	indicator species	C	f
<i>Euclea divinorum</i>	indicator species	C	f
<i>Fagaropsis angolensis</i>	indicator species	C	f
<i>Margaritaria discoidea</i>	indicator species	C	C
<i>Markhamia lutea</i>	indicator species	C	f
<i>Newtonia buchananii</i>	indicator species (but near streams)	x	f
<i>Olea europaea</i>	indicator species ( <i>Olea europaea</i> ssp. <i>cuspidata</i> , synonym: <i>Olea africana</i> )	C	f
<i>Schrebera alata</i>	indicator species	C	f
<i>Strychnos usambarensis</i>	indicator species	x	f
<i>Suregada procera</i>	indicator species	x	f
<i>Trichocladus ellipticus</i>	indicator species	x	f
<i>Uvariadendron anisatum</i>	indicator species	C	
<i>Warburgia ugandensis</i>	indicator species	C	f
<i>Apodytes dimidiata</i>	characteristic species	x	f
<i>Diospyros abyssinica</i>	characteristic species	C	f
<i>Drypetes gerrardii</i>	characteristic species	C	C
<i>Elaeodendron buchananii</i>	characteristic species (dry evergreen forest in the greater Serengeti region)	C	f
<i>Vepris trichocarpa</i>	characteristic species in dry evergreen forest in the greater Serengeti region	C	f
<i>Acacia brevispica</i>		x	f
<i>Acokanthera oppositifolia</i>		x	
<i>Acokanthera schimperi</i>		C	f
<i>Albizia schimperiana</i>		C	f
<i>Allophylus abyssinicus</i>		x	f
<i>Allophylus rubifolius</i>		x	f
<i>Antidesma venosum</i>		x	f
<i>Aphania senegalensis</i>		x	f
<i>Bersama abyssinica</i>		C	x
<i>Blighia unijugata</i>		x	f
<i>Brachylaena huillensis</i>		C	f
<i>Bridelia micrantha</i>		C	f
<i>Bridelia scleroneura</i>		x	f
<i>Caesalpinia decapetala</i>		x	f
<i>Caesalpinia volkensii</i>		x	f
<i>Carissa spinarum</i>		x	f
<i>Catha edulis</i>		x	f
<i>Celtis africana</i>		x	f
<i>Clausena anisata</i>		x	f
<i>Clerodendrum myricoides</i>		x	f
<i>Combretum schumannii</i>		x	f
<i>Commiphora eminii</i>		x	f
<i>Cordia africana</i>		x	f
<i>Cornus volkensii</i>		x	f
<i>Craibia brownii</i>		C	f
<i>Crateva adansonii</i>		x	f
<i>Crotalaria agatiflora</i>		x	f
<i>Croton macrostachyus</i>		C	f
<i>Cussonia spicata</i>		x	f
<i>Dodonaea viscosa</i>		x	f
<i>Dombeya kirkii</i>		x	f
<i>Dovyalis abyssinica</i>		x	f
<i>Dovyalis macrocalyx</i>		x	f
<i>Dracaena steudneri</i>		C	f
<i>Ehretia cymosa</i>		C	
<i>Ekebergia benguelensis</i>		x	f
<i>Ekebergia capensis</i>		C	f
<i>Englerophytum natalense</i>		x	f
<i>Euclea racemosa</i>		x	f
<i>Euphorbia abyssinica</i>		x	f
<i>Euphorbia candelabrum</i>		x	f
<i>Ficus natalensis</i>		x	f
<i>Ficus sur</i>		C	f
<i>Ficus thonningii</i>		C	f
<i>Filicium decipiens</i>		x	f
<i>Flacourtia indica</i>		x	f



SPECIES	Regional status	Kenya	Tanzania
<i>Flueggea virosa</i>		x	f
<i>Grewia similis</i>		x	f
<i>Ilex mitis</i>	not characteristic	x	f
<i>Indigofera swaziensis</i>		x	f
<i>Juniperus procera</i>		x	f
<i>Kigelia moosa</i>		x	f
<i>Lannea schweinfurthii</i>		x	f
<i>Lepidotrichilia volkensii</i>		x	f
<i>Manilkara sulcata</i>		x	f
<i>Maytenus arbutifolia</i>		x	f
<i>Maytenus undata</i>		x	f
<i>Meyna tetraphylla</i>		x	f
<i>Mimusops bagshawei</i>		C	f
<i>Mimusops kummel</i>		C	f
<i>Myrsine africana</i>		x	f
<i>Nuxia congesta</i>	not characteristic	C	f
<i>Nuxia floribunda</i>	not characteristic	x	f
<i>Olea capensis</i>	not characteristic	x	f
<i>Olinia rochetiana</i>		x	f
<i>Osyris lanceolata</i>		x	f
<i>Pappea capensis</i>		x	f
<i>Pavetta oliveriana</i>		x	f
<i>Phoenix reclinata</i>	(palm species)	x	f
<i>Phytolacca dodecandra</i>		x	f
<i>Pistacia aethiopica</i>		x	f
<i>Pittosporum viridiflorum</i>		x	f
<i>Plectranthus barbatus</i>		x	f
<i>Podocarpus falcatus</i>	not characteristic	x	f
<i>Podocarpus latifolius</i>	not characteristic	x	f
<i>Podocarpus usambarensis</i>		x	f
<i>Psydrax schimperiana</i>		C	f
<i>Pterolobium stellatum</i>		x	f
<i>Rapanea melanophloeos</i>	not characteristic	x	f
<i>Rhamnus staddo</i>		x	f
<i>Rhoicissus revouilii</i>		x	f
<i>Rhus natalensis</i>		x	f
<i>Rhus vulgaris</i>		x	f
<i>Ritchiea albersii</i>		x	f
<i>Rothmannia urcelliformis</i>		C	f
<i>Rubus apetalus</i>		x	f
<i>Rubus volkensii</i>		x	f
<i>Schefflera volkensii</i>		x	f
<i>Scutia myrtina</i>		x	f
<i>Senecio hadiensis</i>		x	f
<i>Senna didymobotrya</i>		x	f
<i>Senna septemtrionalis</i>		x	f
<i>Shirakiopsis elliptica</i>		C	f
<i>Solanecio cydoniifolius</i>		x	f
<i>Solanecio mannii</i>		x	f
<i>Solanum aculeastrum</i>		x	f
<i>Sorindeia madagascariensis</i>		x	f
<i>Stereospermum kunthianum</i>		x	f
<i>Strychnos henningsii</i>		C	f
<i>Strychnos innocua</i>		x	f
<i>Strychnos mitis</i>		C	x
<i>Synsepalum brevipes</i>		x	f
<i>Syzygium guineense</i>	not characteristic	x	f
<i>Tarenna graveolens</i>		x	f
<i>Trema orientalis</i>		C	f
<i>Uvaria scheffleri</i>		x	f
<i>Vangueria apiculata</i>		x	f
<i>Vangueria infausta</i>		x	f
<i>Vangueria madagascariensis</i>		x	f
<i>Vepris nobilis</i>	characteristic genus, characteristic species in dry evergreen forest in the greater Serengeti region	C	f
<i>Vepris simplicifolia</i>		C	f
<i>Vernonia auriculifera</i>		x	f
<i>Zanthoxylum chalybeum</i>		x	f

# 11. Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest (Fi)

## 11.1. Description

White (1983 p. 46) restricted semi-evergreen forests to forests where some canopy species are briefly deciduous, but not necessarily at the same time, and most members of the understorey are evergreen.

The Lake Victoria regional mosaic consists of floristically impoverished variants of the characteristic vegetation types of the Guineo-Congolian, Sudanian, Zambezian and Somalia-Masai regional centres of endemism, sometimes with an admixture from Afromontane species (White 1983 p. 181). Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest is therefore expected to be a floristically impoverished variant of drier peripheral semi-evergreen Guineo-Congolian rain forests described for the Guineo-Congolian region (White 1983 p. 79). Most of the species of secondary grassland and wooded grassland in the Lake Victoria region also occur in Guineo-Congolian secondary grassland (White 1983 p. 181).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest and no other Lake Victoria forest type) that were listed as characteristic species for one or several national maps include *Alstonia boonei*, *Antiaris toxicaria*, *Chrysophyllum albidum*, *Entandrophragma cylindricum*, *Entandrophragma utile*, *Holoptelea grandis*, *Khaya anthotheca*, *Khaya grandifoliola*, *Mildbraedi dendron excelsum*, *Milicia excelsa*, *Morus mesozygia*, *Piptadeniastrum africanum* and *Pycnanthus angolensis*.

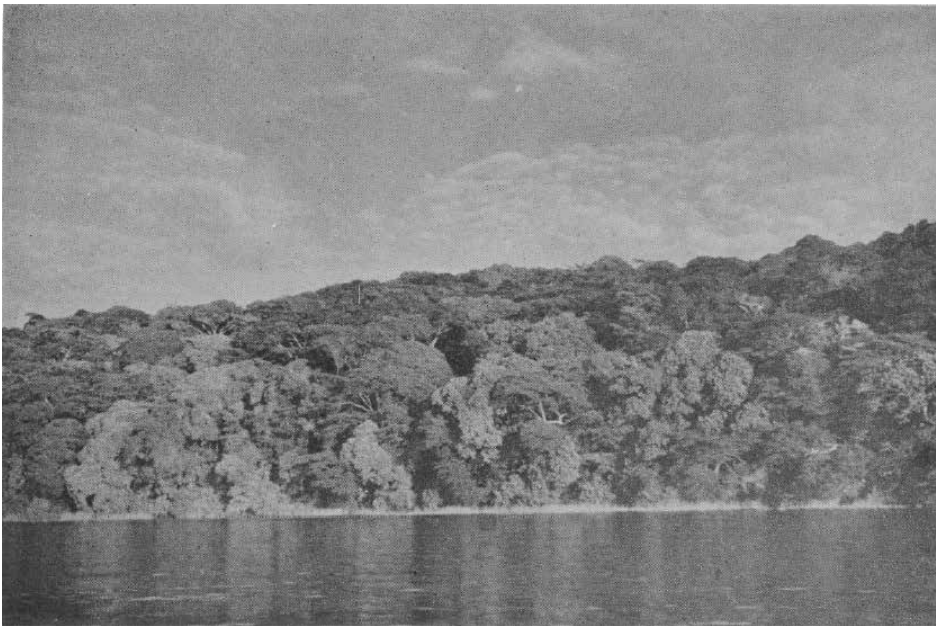


Figure 11.1. Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest on Bukasa Island (Sese Islands, Uganda). Species shown include *Newtonia buchananii* and *Uapaca guineensis*. In the Uganda national map, this forest type was classified as *Piptadeniastrum - Uapaca* forests (C1). Thomas (1941, Fig. 2). Image obtained from URL: <http://www.jstor.org/stable/2256396>



Figure 11.2. Profile diagram of Ironwood forest in Budongo (Uganda). This forest type was classified as Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest in the VECEA map and as *Cynometra - Celtis* forest (D2) in the Uganda national map. Characteristic species include *Cynometra alexandri* ("Cyn" in the figure; ironwood) and *Celtis zenkeri* ("Cz" in the figure). Eggeling (1947, Fig. 9). Image obtained from URL: <http://www.jstor.org/stable/2256760>

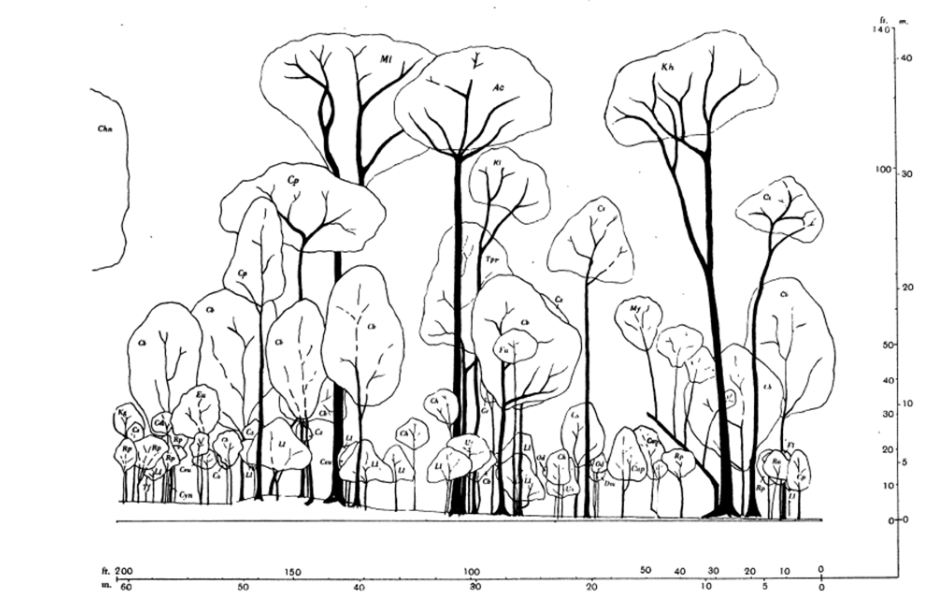


Figure 11.3. Profile diagram of mixed forest in Budongo (Uganda). This forest type may represent a successional stage towards *Cynometra - Celtis* forest (D2; see Figure 11.2). Emergent species include: *Alstonia congensis* ("Ac"), *Khaya anthotheca* ("Kh") and *Mildbraediendron excelsum* ("MI"). Eggeling (1947, Fig. 8). Image obtained from URL: <http://www.jstor.org/stable/2256760>.

## **11.2. Species composition**

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "I" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 11. Species composition of Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest (Fi)

SPECIES	Regional status	Kenya	Tanzania	Uganda (LC1U subtype)	Uganda (LC2U subtype)	Uganda (LC3U subtype)	Uganda (LD1U subtype)	Uganda (LD2U subtype)	Uganda (LD3U subtype)	Uganda (LD4U subtype)
<i>Alstonia boonei</i>	indicator species			f	f	f	C	C	f	C
<i>Antiaris toxicaria</i>	indicator species	f	f	C	C	f	C	x	C	C
<i>Chrysophyllum albidum</i>	indicator species	f		f	C	C	C	x	f	f
<i>Entandrophragma cylindricum</i>	indicator species			f	C	f	f	C	f	f
<i>Entandrophragma utile</i>	indicator species			f	C	f	C	C	f	f
<i>Holoptelea grandis</i>	indicator species			f	x	f	C	C	f	f
<i>Khaya anthotheca</i>	indicator species		f	f	f	f	f	C	f	f
<i>Khaya grandifoliola</i>	indicator species			f	f	f	f	C	f	f
<i>Milbraediodendron excelsum</i>	indicator species			f	f	f	C	C	f	f
<i>Milicia excelsa</i>	indicator species	f	f	f	x	f	f	x	f	C
<i>Morus mesozygia</i>	indicator species	f	f	f	C	f	f	x	f	f
<i>Piptadeniastrum africanum</i>	indicator species			C	C	f	f	x	f	f
<i>Pycnanthus angolensis</i>	indicator species		f	C	C	f	f	x	f	f
<i>Cynometra alexandri</i>	characteristic species		f	f	f	f	f	C	f	f
<i>Entandrophragma angolense</i>	characteristic species	f	f	f	C	f	C	C	f	f
<i>Maesopsis eminii</i>	characteristic species	f	f	C	C	C	C	C	f	f
<i>Pouteria altissima</i>	characteristic species	f	f	f	C	C	f	x	f	f
<i>Albizia coriaria</i>		f	f	f	f	f	C	f	C	C
<i>Albizia glaberrima</i>		f	f	f	C	f	C	x	f	C
<i>Albizia grandibracteata</i>		f	f	f	C	f	C	C	C	C
<i>Albizia gummifera</i>		f	f	f	C	C	f	x	C	f
<i>Albizia zygia</i>		f	f	f	C	f	C	x	f	C
<i>Balanites wilsoniana</i>		f	f	f	x	f	f	C	f	f
<i>Beilschmiedia ugandensis</i>			f	f	x	f	f	x	f	f
<i>Blighia unijugata</i>		f	f	f	x	f	x	x	C	f
<i>Bombax buonopozense</i>				f	f	f	f	C	f	f
<i>Canarium schweinfurthii</i>			f	C	x	f	f	x	f	C
<i>Cassipourea ruwensoriensis</i>		f	f	f	f	x	f	x	f	f
<i>Celtis adolfi-fridericii</i>	characteristic genus			f	f	f	x	C	f	f
<i>Celtis africana</i>	characteristic genus	f	f	f	C	f	C	C	C	C
<i>Celtis gomphophylla</i>	characteristic genus	f	f	f	C	f	C	x	f	f
<i>Celtis mildbraedii</i>	characteristic genus	f	f	f	C	f	C	C	f	f
<i>Celtis philippensis</i>	characteristic genus	f	f	f	f	f	C	x	f	f
<i>Celtis zenkeri</i>	characteristic genus		f	f	C	f	C	C	f	C
<i>Chrysophyllum gorungosanum</i>		f	f	f	f	C	f	f	f	f
<i>Clausena anisata</i>		f	f	f	x	f	x	x	x	x
<i>Croton macrostachyus</i>		f	f	f	x	f	f	x	C	C
<i>Croton megalocarpus</i>		f	f	f	f	C	f	x	f	f
<i>Diospyros abyssinica</i>		f	f	f	x	x	C	x	f	x
<i>Dombeya kirkii</i>		f	f	f	f	x	x	x	f	f
<i>Dracaena fragrans</i>		f	f	x	x	f	x	f	f	f
<i>Entandrophragma excelsum</i>			f	f	x	C	f	f	f	f
<i>Erythrina excelsa</i>		f	f	f	x	f	f	x	f	f
<i>Erythrophleum suaveolens</i>		f	f	f	f	f	C	C	f	f
<i>Fagaropsis angolensis</i>		f	f	f	x	f	f	x	C	C
<i>Ficus mucosa</i>		f	f	f	C	f	f	x	f	f
<i>Flueggea virosa</i>		f	f	f	x	f	f	x	f	x
<i>Funtumia africana</i>		f	f	x	x	x	C	x	f	f
<i>Funtumia elastica</i>				f	f	f	C	x	f	f
<i>Hallea stipulosa</i>				f	x	f	f	x	f	f
<i>Harrisonia abyssinica</i>		f	f	f	f	f	f	x	f	x
<i>Lannea welwitschii</i>		f	f	f	x	f	f	x	f	f
<i>Lovoa swynnertonii</i>		f	f	f	x	C	f	x	f	f
<i>Lovoa trichilioides</i>			f	C	C	f	f	x	f	f
<i>Maesa lanceolata</i>		f	f	f	x	x	f	x	f	f
<i>Manilkara dawei</i>			f	f	x	f	f	x	f	f
<i>Margaritaria discoidea</i>		f	f	f	x	f	f	C	C	C
<i>Markhamia lutea</i>		f	f	f	x	f	x	x	C	C
<i>Mimusops bagshawei</i>		f	f	C	C	f	C	x	f	C
<i>Morinda lucida</i>			f	f	x	f	f	x	f	f
<i>Myrianthus arboreus</i>			f	f	f	f	f	x	f	f
<i>Nauclea diderrichii</i>				f	f	f	f	x	f	f
<i>Newtonia buchananii</i>		f	f	C	f	C	f	x	f	f
<i>Olea capensis</i>		f	f	f	f	C	f	C	C	f



SPECIES	Regional status	Kenya	Tanzania	Uganda (LC1U subtype)	Uganda (LC2U subtype)	Uganda (LC3U subtype)	Uganda (LD1U subtype)	Uganda (LD2U subtype)	Uganda (LD3U subtype)	Uganda (LD4U subtype)
<i>Parinari excelsa</i>			f	f	C	C	f	x	f	f
<i>Pleiocarpa pycnantha</i>		f	f	f	x	x	f	x	f	f
<i>Polyscias fulva</i>		f	f	x	x	x	f	x	C	f
<i>Prunus africana</i>		f	f	f	x	C	f	x	C	C
<i>Pseudospondias microcarpa</i>		f	f	C	x	f	f	x	f	C
<i>Pterolobium stellatum</i>		f	f	f	x	f	x	x	f	f
<i>Pterygota mildbraedii</i>			f	f	f	f	f	C	f	f
<i>Raphia farinifera</i>	(palm species)	f	f	f	x	f	f	x	f	f
<i>Rauvolfia vomitoria</i>			f	f	x	f	f	x	f	f
<i>Schrebera arborea</i>		f		f	f	f	C	C	f	f
<i>Scutia myrtina</i>		f	f	f	f	f	x	x	f	x
<i>Shirakiopsis elliptica</i>		f	f	f	x	C	f	x	C	C
<i>Strombosia scheffleri</i>		f	f	f	x	C	f	x	f	f
<i>Strychnos mitis</i>		f	f	f	x	f	C	C	f	f
<i>Symphonia globulifera</i>			f	C	x	C	f	x	f	f
<i>Synsepalum brevipes</i>		f	f	C	x	f	x	x	f	f
<i>Tabernaemontana pachysiphon</i>		f	f	x	x	f	f	x	f	f
<i>Trema orientalis</i>		f	f	f	x	x	f	x	f	f
<i>Trichilia dregeana</i>		f	f	C	x	f	f	C	f	f
<i>Trilepisium madagascariense</i>		f	f	x	x	f	C	x	f	f
<i>Uapaca guineensis</i>	(one of the more important species of Lake Victoria swamp forest)		f	C	f	f	f	f	f	f
<i>Vepris nobilis</i>		f	f	f	x	f	C	x	x	C
<i>Vernonia amygdalina</i>		f	f	f	x	f	f	x	x	f
<i>Vernonia auriculifera</i>		f	f	f	f	f	f	f	x	C
<i>Warburgia ugandensis</i>		f	f	f	f	f	C	x	f	f
<i>Xylopia aethiopica</i>		f	f	x	f	f	f	x	f	f
<i>Zanthoxylum gillettii</i>		f	f	f	x	f	f	x	f	f

## 12. Zanzibar-Inhambane lowland rain forest (Fo)

### 12.1. Description

Zanzibar-Inhambane lowland rain forest has a main canopy that is almost evergreen and up to 20 m high. Emergents are 40 m or taller. This forest differs from Guineo-Congolian rain forests in greater degrees of bud protection, less developed drip-tips of leaves and low numbers of epiphytes (White 1983 p. 186).

Zanzibar-Inhambane lowland rain forests (Fo) differ from Zanzibar-Inhambane transitional rain forests (Fg) by occurring at lower altitudes (< 900 m) and having no admixture of Afromontane species (White 1983 p. 186). Zanzibar-Inhambane lowland rain forests were formerly extensively developed along the lower parts of the eastern highlands arc (especially the Nguru, Uluguru and Usambara Mts. of Tanzania), but only small fragments remain. Similar forests occur further inland as exclaves of the Zanzibar-Inhambane floristic region in other floristic regions such as on the Malawi Hills (within the Zambezian region) or near Tavetta (within the Somalia-Masai region; its presence is a result from the high water table in that location<sup>5</sup>; White 1983 p. 186).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Zanzibar-Inhambane lowland rain forest and no other Zanzibar-Inhambane forest type) that were listed as characteristic species for one or several national maps ('indicators', see section 14.2) only include *Burttidavya nyasica*, *Khaya anthotheca* and *Pouteria pseudoracemosa*. Most of the other characteristic species listed by White were also listed as characteristic species for other Zanzibar-Inhambane forest types (see section 14.2).

### 12.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

5: Dale (1939) mapped two patches of forests near Tavetta (and north of Lake Jipe) and classified these as "lowland evergreen edaphic forest". He describes them as forests that are unique in Kenya, but are similar in composition with the Lower Pare forests in Tanganyika and have also affinities with the S. Digo forests on the coast. These forests already were of small extent (not more than two square miles [ $\sim 5 \text{ km}^2$ ]) and occurred on volcanic ash in the vicinity of streams and rivers. Based on the description of the high water table, an alternative classification method could be as swamp forest (fs).

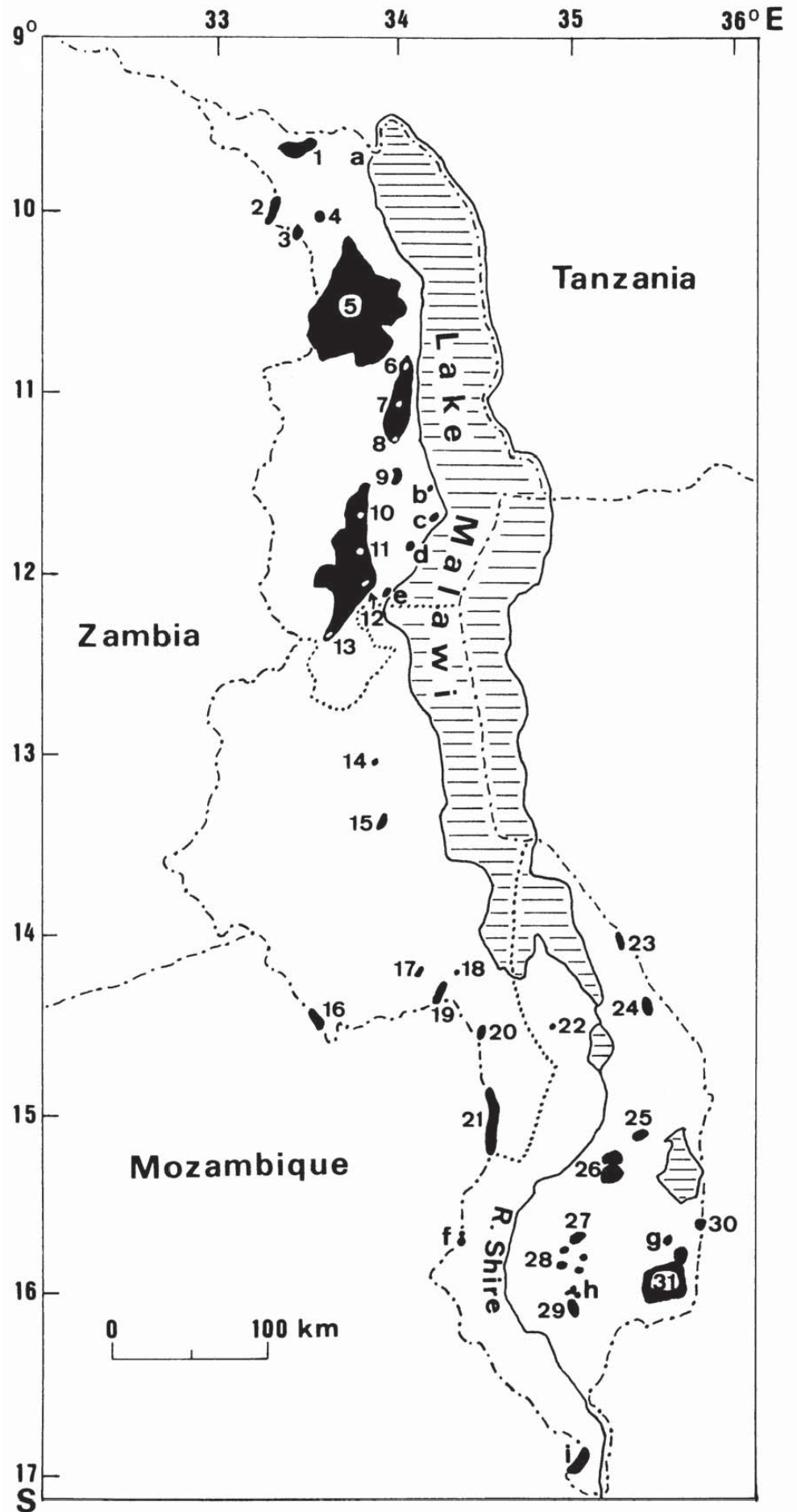


Figure 12.1. Distribution of Zanzibar-Inhambane lowland rain forest (Fo) in Malawi according to Dowsett-Lemaire (1990, Fig. 1). a: Igembe Hill; b: Kalwe (Nkhata Bay), c: Nkuwadzi; d: Mzuma (Chintheche), e: Kuwilwe Hill; f: Thambani and Zobue Hills, g: Machemba Hill; h: Thyolo tea estates; i: Malawi Hills and 31: foot of Mt. Mulanje (locations with numbers 1 – 30 refer to areas of Afromontane forests and Zanzibar-Inhambane transitional rain forest in Malawi). Image obtained from URL: <http://www.jstor.org/stable/3668330>.

Table 12. Species composition for Zanzibar-Inhambane lowland rain forest (Fo)

SPECIES	Regional status	Malawi	Tanzania
<i>Burttidavya nyasica</i>	indicator species	C	f
<i>Khaya anthotheca</i>	indicator species	C	C
<i>Pouteria pseudoracemosa</i>	indicator species (very local)		C
<i>Antiaris toxicaria</i>	characteristic species		f
<i>Cordyla africana</i>	characteristic species	x	f
<i>Diospyros mespiliformis</i>	characteristic species	C	f
<i>Lovoa swynnertonii</i>	characteristic species		f
<i>Maranthes goetzeniana</i>	characteristic species		f
<i>Milicia excelsa</i>	characteristic species	C	C
<i>Newtonia buchananii</i>	characteristic species	C	f
<i>Parkia filicoidea</i>	characteristic species	C	C
<i>Ricinodendron heudelotii</i>	characteristic species		C
<i>Sterculia appendiculata</i>	characteristic species	f	f
<i>Terminalia sambesiaca</i>	characteristic species	C	C
<i>Albizia adianthifolia</i>	not characteristic	C	f
<i>Anthocleista grandiflora</i>		C	C
<i>Blighia unijugata</i>		x	f
<i>Bombax rhodognaphalon</i>		C	C
<i>Brachystegia spiciformis</i>		C	f
<i>Calodendrum capense</i>		x	f
<i>Celtis africana</i>		x	f
<i>Celtis gomphophylla</i>		C	f
<i>Croton sylvaticus</i>		C	f
<i>Diospyros abyssinica</i>	not characteristic	C	f
<i>Dovyalis macrocalyx</i>		x	f
<i>Ekebergia capensis</i>		x	f
<i>Englerophytum natalense</i>		x	C
<i>Erythrophleum suaveolens</i>	not characteristic	C	C
<i>Ficus exasperata</i>		x	f
<i>Ficus sur</i>		C	f
<i>Ficus thonningii</i>		C	
<i>Ficus vallis-choudae</i>	not characteristic	C	f
<i>Filicium decipiens</i>		x	C
<i>Funtumia africana</i>	not characteristic	C	C
<i>Garcinia buchananii</i>		x	C
<i>Harrisonia abyssinica</i>		x	f
<i>Landolphia buchananii</i>		x	
<i>Landolphia kirkii</i>		x	f
<i>Lecaniodiscus fraxinifolius</i>		x	f
<i>Macaranga capensis</i>	not characteristic	x	f
<i>Margaritaria discoidea</i>		x	f
<i>Olyra latifolia</i>			C
<i>Oreobambos buchwaldii</i>	(bamboo species indigenous to Africa)	x	
<i>Parinari excelsa</i>		f	C
<i>Phoenix reclinata</i>	(palm species)	x	f
<i>Pterocarpus tinctorius</i>		C	f
<i>Rauvolfia caffra</i>	not characteristic	C	f
<i>Saba comorensis</i>		x	
<i>Shirakiopsis elliptica</i>		x	C
<i>Sorindeia madagascariensis</i>		C	C
<i>Synsepalum brevipes</i>	not characteristic	x	f
<i>Syzygium guineense</i>		x	f
<i>Tabernaemontana pachysiphon</i>		x	C
<i>Treulia africana</i>	not characteristic	f	C
<i>Trichilia dregeana</i>		C	f
<i>Trilepisium madagascariense</i>	not characteristic	C	C
<i>Zanha golungensis</i>		C	C

# 13. Zanzibar-Inhambane undifferentiated forest (Fp)

## 13.1. Description

White (1983) reserved the term of “undifferentiated forests” to forests that undergo rapid and kaleidoscopic changes in structure and species composition over short distances (White 1983 p. 47).

A distinction can be made between moister and drier variants of Zanzibar-Inhambane undifferentiated forest:

- The moister variants have a main canopy at 15 to 20 m with emergents of 30 to 35 m. Many of the canopy species are briefly deciduous, although not concurrently, but appreciably more deciduous than semi-evergreen lowland rain forests (e.g., Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest [Fi]). The floristically richest types of moister variants of Zanzibar-Inhambane undifferentiated forests occur in Kenya and northern Tanzania (White 1983 p. 187).
- The drier forest variants are floristically more diverse than the moister variants. Most of the larger tree species are locally dominant or co-dominant and sometimes gregarious. The drier forests cover a larger area than the moister forests and also extend further to the north and south (White 1983 p. 187).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Zanzibar-Inhambane undifferentiated forest and no other Zanzibar-Inhambane forest type) that were listed as characteristic species for one or several national maps can be further classified as characteristic species only listed for moister forest variants, only listed for drier forest variants or listed for both moister and drier variants:

- Characteristic species for moister forest variants: ***Albizia adianthifolia***, ***Apodytes dimidiata*** (also characteristic of Afromontane undifferentiated forest [Fbu], Afromontane dry transitional forest [Fh] and Lake Victoria transitional rain forest [Ff]), ***Bombax rhodognaphalon***, ***Celtis philippensis***, ***Cola clavata***, ***Diospyros abyssinica*** (also a characteristic species of Afromontane rain forest [Fa] and Afromontane dry transitional forest [Fh]), ***Erythrina saclexii***, ***Erythrophleum suaveolens***, ***Fernandoa magnifica***, ***Ficus vallis-choudae***, ***Inhambanella henriquesii***, ***Lannea welwitschii***, ***Malacantha alnifolia***, ***Mimusops aedificatoria***, ***Nesogordonia holtzii***, ***Paramacrolobium coeruleum***, ***Synsepalum brevipes*** and ***Xylopia parviflora***.
- Characteristic species for drier forest variants: ***Acacia robusta***, ***Albizia petersiana***, ***Brachylaena huillensis***, ***Cassipourea euryoides***, ***Cussonia zimmermannii***, ***Cynometra webberi***, ***Manilkara sulcata***, ***Oldfieldia somalensis***, ***Pleurostyliia africana***, ***Scorodophloeus fischeri***, ***Tamarindus indica*** and ***Warneckea sansibarica***.



- Characteristic species both for moister and drier forest variants:  
*Afzelia quanzensis*, *Balanites wilsoniana*, *Combretum schumannii*, *Hymenaea verrucosa*, *Julbernardia magnistipulata*, *Manilkara sansibarensis* and *Newtonia paucijuga*.

More information on coastal forests can be obtained from URL <http://coastalforests.tfcg.org/> (last accessed June 2011).

### 13.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 13. Species composition of Zanzibar-Inhambane undifferentiated forest (Fp)

SPECIES	Regional status	Coast (Fp/C subtype)			
		Coast (Fp/C subtype)	Coast (Fp/C subtype)	Coast (Fp/C subtype)	Coast (secondary WsC subtype)
<i>Acacia robusta</i>	indicator species (drier forest variants)	f	x		
<i>Afzelia quanzensis</i>	indicator species (moister and drier forest variants)	C	C	f	
<i>Albizia adianthifolia</i>	indicator species (moister forest variants)	C	C	f	
<i>Albizia petersiana</i>	indicator species (drier forest variants)	C	C		
<i>Apodytes dimidiata</i>	indicator species (moister forest variants)			f	
<i>Balanites wilsoniana</i>	indicator species (moister and drier forest variants)		C	f	
<i>Bombax rhodognaphalon</i>	indicator species (moister forest variants)		C	C	
<i>Brachylaena huillensis</i>	indicator species (drier forest variants)	x	C		
<i>Cassipourea euryoides</i>	indicator species (drier forest variants)	x	C		
<i>Celtis philippensis</i>	indicator species (moister forest variants)		x	C	
<i>Cola clavata</i>	indicator species (moister forest variants)		C	f	
<i>Combretum schumannii</i>	indicator species (moister and drier forest variants)		C	x	
<i>Cussonia zimmermannii</i>	indicator species (drier forest variants)	f	C	C	
<i>Cynometra webberi</i>	indicator species (drier forest variants)	C	x		
<i>Diospyros abyssinica</i>	indicator species (moister forest variants, but very rare)		x	C	
<i>Erythrina saculeuxii</i>	indicator species (moister forest variants)	C	x	x	
<i>Erythrophleum suaveolens</i>	indicator species (moister forest variants)	C	C	C	
<i>Fernandoa magnifica</i>	indicator species (moister forest variants)		C	C	
<i>Ficus vallis-choudae</i>	indicator species (moister forest variants)			f	
<i>Hymenaea verrucosa</i>	indicator species (moister and drier forest variants)	C	C	x	
<i>Inhambanella henriquesii</i>	indicator species (moister forest variants)		C	f	
<i>Julbernardia magnistipulata</i>	indicator species (moister and drier forest variants)	C	C	x	
<i>Lannea welwitschii</i>	indicator species (moister forest variants)		x	f	
<i>Malacantha alnifolia</i>	indicator species (moister forest variants)			f	
<i>Manilkara sansibarensis</i>	indicator species (moister and drier forest variants)	x	C	f	
<i>Manilkara sulcata</i>	indicator species (drier forest variants)	x	C		
<i>Mimusops aedificatoria</i>	indicator species (moister forest variants)			x	
<i>Nesogordonia holtzii</i>	indicator species (moister forest variants)	x	C	x	
<i>Newtonia paucijuga</i>	indicator species (moister and drier forest variants)	f	C	C	
<i>Oldfieldia somalensis</i>	indicator species (drier forest variants)	x	x		
<i>Paramacrolobium coeruleum</i>	indicator species (moister forest variants)	C	x	x	
<i>Pleurostyliia africana</i>	indicator species (drier forest variants)		x		
<i>Scorodophloeus fischeri</i>	indicator species (drier forest variants)	C	C	C	
<i>Synsepalum brevipes</i>	indicator species (moister forest variants)	x	C	C	
<i>Tamarindus indica</i>	indicator species (drier forest variants)		C		
<i>Warneckea sansibarica</i>	indicator species (drier forest variants)	f	f		
<i>Xylopia parviflora</i>	indicator species (moister forest variants)		C	C	
<i>Antiaris toxicaria</i>	characteristic species (moister forest variants)		C	C	
<i>Cordyla africana</i>	characteristic species (moister forest variants)		C	C	
<i>Diospyros mespiliformis</i>	characteristic species (moister forest variants)		C	x	
<i>Lovoa swynnertonii</i>	characteristic species (moister forest variants)		x	x	
<i>Macaranga capensis</i>	characteristic species (moister forest variants)		x	f	
<i>Milicia excelsa</i>	characteristic species (moister and drier forest variants)		C	C	x
<i>Parkia filicoidea</i>	characteristic species (moister forest variants)		x	C	
<i>Ricinodendron heudelotii</i>	characteristic species (moister forest variants)	x	C	C	
<i>Sterculia appendiculata</i>	characteristic species (moister and drier forest variants)		C	C	x
<i>Terminalia sambesiaca</i>	characteristic species (moister forest variants)		C	x	
<i>Trilepisium madagascariense</i>	characteristic species (moister and drier forest variants)		C	x	
<i>Acacia polyacantha</i>			C		
<i>Acacia senegal</i>	(secondary grassland and wooded grassland)				x
<i>Adansonia digitata</i>	probably introduced by humans and does not regenerate under a closed forest canopy		C		x
<i>Albizia glaberrima</i>		x	C	x	
<i>Albizia gummifera</i>		x	C	x	
<i>Albizia versicolor</i>			C		
<i>Annona senegalensis</i>	(secondary grassland and wooded grassland)				x
<i>Anthocleista grandiflora</i>			C	C	
<i>Antidesma venosum</i>	(secondary grassland and wooded grassland)				x
<i>Bersama abyssinica</i>			C	x	
<i>Blighia unijugata</i>			x	C	
<i>Borassus aethiopum</i>	(secondary grassland and wooded grassland)				x
<i>Brachystegia spiciformis</i>			C		

SPECIES	Regional status	Coast (Fp/C subtype)	Coast (FpdC subtype)	Coast (FpmC subtype)	Coast (secondary WsC subtype)
<i>Celtis gomphophylla</i>			C	f	
<i>Celtis mildbraedii</i>			x	x	
<i>Crossopteryx febrifuga</i>	(secondary grassland and wooded grassland)				x
<i>Croton sylvaticus</i>			C	x	
<i>Dalbergia melanoxylon</i>	(secondary grassland and wooded grassland)				x
<i>Dialium orientale</i>			C		
<i>Dichrostachys cinerea</i>	(secondary grassland and wooded grassland)				x
<i>Ekebergia capensis</i>		x	C	C	
<i>Elaeis guineensis</i>	(palm species)		x	C	
<i>Encephalartos hildebrandtii</i>	cycad species that is locally plentiful in drier forest variants		f		
<i>Englerophytum natalense</i>				C	
<i>Fagaropsis angolensis</i>			C		
<i>Ficus sur</i>			C		
<i>Flacourtia indica</i>	(secondary grassland and wooded grassland)		C		x
<i>Funtumia africana</i>	not characteristic		C	C	
<i>Garcinia buchananii</i>		x	C		
<i>Garcinia livingstonei</i>			C	x	
<i>Harrisonia abyssinica</i>	(secondary grassland and wooded grassland)				x
<i>Hyphaene compressa</i>	(secondary grassland and wooded grassland, palm species)				x
<i>Khaya anthotheca</i>	not characteristic	x	C	C	
<i>Lannea schweinfurthii</i>	(secondary grassland and wooded grassland)		C		x
<i>Lecaniodiscus fraxinifolius</i>			C	x	
<i>Markhamia obtusifolia</i>		x	x		
<i>Markhamia zanzibarica</i>			C		
<i>Maytenus senegalensis</i>	(secondary grassland and wooded grassland)				x
<i>Mimusops obtusifolia</i>			C		
<i>Monodora grandidieri</i>			C		
<i>Newtonia buchananii</i>	not characteristic	C	C	C	
<i>Parinari excelsa</i>			C		
<i>Piliostigma thonningii</i>	(secondary grassland and wooded grassland)				x
<i>Pterocarpus tinctorius</i>			C		
<i>Sclerocarya birrea</i>	(secondary grassland and wooded grassland)				x
<i>Securidaca longipedunculata</i>	(secondary grassland and wooded grassland)				x
<i>Sideroxylon inerme</i>	not characteristic		C		
<i>Sorindeia madagascariensis</i>		x	C	C	
<i>Stereospermum kunthianum</i>	(secondary grassland and wooded grassland)				x
<i>Strychnos henningsii</i>		x	C		
<i>Strychnos mitis</i>	not characteristic		x	x	
<i>Strychnos spinosa</i>	(secondary grassland and wooded grassland)				x
<i>Syzygium cordatum</i>			C		
<i>Syzygium guineense</i>			C		
<i>Tabernaemontana pachysiphon</i>			C	C	
<i>Trema orientalis</i>			C		
<i>Trichillia emetica</i>			C	C	
<i>Vitex doniana</i>			x	C	
<i>Vitex mombassae</i>	(secondary grassland and wooded grassland)				x
<i>Zanha golungensis</i>			x	C	
<i>Zanthoxylum chalybeum</i>			C		
<i>Ziziphus pubescens</i>			C		

## 14. Zanzibar-Inhambane scrub forest (Fq)

### 14.1. Description

Zanzibar-Inhambane scrub forest forms a quasi-continuous belt that separates the forests of the coastal region (*i.e.* Zanzibar-Inhambane undifferentiated forest [Fp]) from the bushlands of the interior (*i.e.* especially deciduous bushland [Bd]). This forest reaches the Kenyan coast between Malindi and Lamu, where the rainfall is lower than elsewhere, and extends to southern Tanzania. *Diospyros cornii* forms a discontinuous upper canopy of 9 to 15 m high. *Manilkara mochisia* is an almost constant associate, but is less plentiful. In many places, scrub forest has been degraded and converted into secondary deciduous bushland (White 1983 p. 188). *Diospyros cornii* and *Manilkara mochisia* are also emergent trees on termite mounds within Zanzibar-Inhambane edaphic grassland (White 1983 p. 189).

The annual rainfall is between 500 and 750 mm (White 1983 p. 188). Besides the dominant *Diospyros cornii* and *Manilkara mochisia*, regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Zanzibar-Inhambane scrub forest and no other Zanzibar-Inhambane forest types) that were listed as characteristic species for the national maps include *Adenia globosa*, *Bivinia jalbertii*, *Catunaregam nilotica*, *Croton pseudopulchellus*, *Diospyros consolatae*, *Dobera glabra* (abundant especially where the water-table is near the surface), *Euclea natalensis*, *Euclea racemosa*, *Euphorbia candelabrum* (rare), *Euphorbia grandicornis*, *Grandidiera boivinii*, *Haplocoelum foliolosum*, *Haplocoelum inoploeum*, *Newtonia erlangeri* (only in northern scrub forests), *Ochna thomasi*, *Sideroxylon inerme*, *Spirostachys venenifera*, *Suregada zanzibariensis*, *Thespesia danis* and *Thylachium africanum*.

### 14.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 14. Species composition of Zanzibar-Inhambane scrub forest (Fq)

SPECIES	Regional status	Coast
<i>Diospyros cornii</i>	dominant	D
<i>Manilkara mocharisia</i>	dominant	D
<i>Adenia globosa</i>	indicator species	x
<i>Bivinia jalbertii</i>	indicator species	f
<i>Catunaregam nilotica</i>	indicator species	f
<i>Croton pseudopulchellus</i>	indicator species	x
<i>Diospyros consolatae</i>	indicator species	x
<i>Dobera glabra</i>	indicator species (abundant especially where the water-table is near the surface)	f
<i>Euclea natalensis</i>	indicator species	x
<i>Euclea racemosa</i>	indicator species	f
<i>Euphorbia candelabrum</i>	indicator species (rare and often absent)	f
<i>Euphorbia grandicornis</i>	indicator species (dense communities in the understorey)	f
<i>Grandidiera boivinii</i>	indicator species	f
<i>Haplocoelum foliolosum</i>	indicator species	f
<i>Haplocoelum inoploeum</i>	indicator species	x
<i>Newtonia erlangeri</i>	indicator species (only in northern forests)	x
<i>Ochna thomasiana</i>	indicator species	f
<i>Sideroxylon inerme</i>	indicator species	f
<i>Spirostachys venenifera</i>	indicator species	x
<i>Suregada zanzibariensis</i>	indicator species	x
<i>Thespesia danis</i>	indicator species	x
<i>Thylachium africanum</i>	indicator species	x
<i>Acacia brevispica</i>		x
<i>Acacia bussei</i>	secondary species	f
<i>Acacia mellifera</i>	secondary species	f
<i>Acacia nilotica</i>	secondary species	f
<i>Azalia quanzensis</i>	not characteristic	x
<i>Albizia adianthifolia</i>	not characteristic	x
<i>Albizia anthelmintica</i>	secondary species	x
<i>Albizia petersiana</i>	not characteristic	x
<i>Albizia versicolor</i>		x
<i>Allophylus rubifolius</i>		x
<i>Bombax rhodognaphalon</i>	not characteristic	x
<i>Boscia salicifolia</i>		x
<i>Brachylaena huillensis</i>	not characteristic	x
<i>Carissa spinarum</i>		x
<i>Combretum schumannii</i>	not characteristic	x
<i>Cordia africana</i>	not characteristic	x
<i>Dalbergia nitidula</i>		x
<i>Dialium orientale</i>		x
<i>Diospyros mespiliformis</i>	not characteristic	x
<i>Euphorbia tirucalli</i>		x
<i>Garcinia livingstonei</i>		x
<i>Grewia villosa</i>		x
<i>Harrisonia abyssinica</i>		x
<i>Hymenaea verrucosa</i>	not characteristic	x
<i>Hyphaene compressa</i>	secondary species (palm species)	f
<i>Lecaniodiscus fraxinifolius</i>		x
<i>Manilkara sansibarensis</i>	not characteristic	x
<i>Manilkara sulcata</i>	not characteristic	x
<i>Markhamia obtusifolia</i>		x
<i>Milicia excelsa</i>	not characteristic	x
<i>Olea europaea</i>	( <i>Olea europaea</i> ssp. <i>cuspidata</i> , synonym: <i>Olea africana</i> )	x
<i>Sorindeia madagascariensis</i>		x
<i>Strychnos henningsii</i>		x
<i>Strychnos innocua</i>		x
<i>Syzygium cordatum</i>		x
<i>Syzygium guineense</i>		x
<i>Terminalia prunioides</i>		x
<i>Terminalia spinosa</i>	indicator of disturbance	f
<i>Vitex doniana</i>		x
<i>Vitex payson</i>		x
<i>Zanthoxylum chalybeum</i>		x



## 15. Zanzibar-Inhambane scrub forest on coral rag (edaphic forest type, fc)

### 15.1. Description

White describes evergreen thickets that are the climax vegetation types on shallow soils that overlie coral limestone and that have rainfall between 950 and 1200 mm per year. We decided to equate this vegetation type with the “maritime eastern African coastal scrub forest” described by Clarke and Robertson (2000) who described these forests as scrub forests and thickets (with canopies of 6 - 10 m and occasional emergents of 8 - 15 m) that develop on shallow and easily dessicated soils that overly coral rag (*i.e.* surface limestone derived from recent corals). Both White (1983) and Clarke and Robertson (2000) refer to the same reference of Birch (1963) when describing this vegetation type.

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Zanzibar-Inhambane scrub forest on coral rag and no other Zanzibar-Inhambane forest types, include ***Carpodiptera africana***, ***Diospyros squarrosa***, ***Grewia plagiophylla***, ***Grewia truncata***, ***Harrisonia abyssinica***, ***Lannea schweinfurthii***, ***Ludia mauritiana***, ***Millettia usaramensis***, ***Monanthotaxis fornicata***, ***Pycnocomia littoralis***, ***Sterculia rhynchocarpa***, ***Tabernaemontana elegans***, ***Uvaria leptocladon*** and ***Zanthoxylum chalybeum***.

### 15.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 15. Species composition of Zanzibar-Inhambane scrub forest on coral rag (edaphic forest type, fc)

SPECIES	Regional status	Coast
<i>Carpodiptera africana</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Diospyros squarrosa</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Grewia plagiophylla</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Grewia truncata</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Harrisonia abyssinica</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Lannea schweinfurthii</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Ludia mauritiana</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Millettia usaramensis</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Monanthes taxifolia</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Pycnocomia littoralis</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Sterculia rhynchocarpa</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Tabernaemontana elegans</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Uvaria leptocladon</i>	indicator species (evergreen thicket on coral limestone)	f
<i>Zanthoxylum chalybeum</i>	indicator species (evergreen thicket on coral limestone)	x
<i>Manilkara sansibarensis</i>	characteristic species (evergreen thicket on coral limestone)	x
<i>Adansonia digitata</i>		x
<i>Azizelia quanzensis</i>	not characteristic	x
<i>Antiaris toxicaria</i>	not characteristic	x
<i>Bombax rhodognaphalon</i>	not characteristic	x
<i>Bridelia micrantha</i>		x
<i>Combretum schumannii</i>	not characteristic	x
<i>Dialium orientale</i>		x
<i>Dichrostachys cinerea</i>		x
<i>Diospyros mespiliformis</i>	not characteristic	x
<i>Dodonaea viscosa</i>		x
<i>Encephalartos hildebrandtii</i>		x
<i>Euclea racemosa</i>	not characteristic	x
<i>Euphorbia tirucalli</i>		x
<i>Ficus sur</i>		x
<i>Flacourtia indica</i>		x
<i>Flueggea virosa</i>		x
<i>Manilkara sulcata</i>	not characteristic	x
<i>Markhamia zanzibarica</i>		x
<i>Mimusops obtusifolia</i>		x
<i>Monodora grandidieri</i>		x
<i>Ozoroa insignis</i>		x
<i>Pandanus kirkii</i>	genus occurs in Zanzibar-Inhambane swamp forest	x
<i>Psydrax schimperiana</i>		x
<i>Pterocarpus angolensis</i>		x
<i>Ricinodendron heudelotii</i>	not characteristic	x
<i>Salvadora persica</i>		x
<i>Sclerocarya birrea</i>		x
<i>Sideroxylon inerme</i>	not characteristic	x
<i>Sorindeia madagascariensis</i>		x
<i>Sterculia africana</i>		x
<i>Syzygium cordatum</i>		x
<i>Tamarindus indica</i>	not characteristic	x
<i>Xylopia parviflora</i>	not characteristic	x

## 16. Riverine forests (edaphic forest type, fr)

### 16.1. Description

Although White (1983) treated riverine forests separately within the descriptions of regional centres of endemism, we decided not to map floristic variants of riverine forests. Actually, it was in most situations not practical to map riverine forests.

Zambezian riparian forest can be further classified in: (i) evergreen or semi-evergreen riparian forest; and (ii) deciduous riparian forest. Evergreen or semi-evergreen riparian forest of 20 m (or taller) occurs on fringes or perennial streams in areas where annual rainfall exceeds 1000 mm. Riparian forest where most of the tree species are deciduous for at least two months are confined to the banks of major watercourses in areas where annual rainfall is less than 800 mm. The latter riparian forest type has probably always been kept open by movements and browsing of large mammals, which explains the presence of heliophilous ('sun-loving') species of *Acacia* and other genera (White 1983 p. 91). Evergreen riparian forests are among the associated vegetation types that characterize wetter miombo woodland (Wn), whereas deciduous riparian forests are among the associated vegetation types that characterize drier miombo woodland (White 1983 p. 93).

Sudanian riparian forest was further classified in: (i) semi-evergreen riparian forest; and (ii) semi-deciduous riparian forest. The former occurs in the southern (wetter) half of the Sudanian region, whereas the latter occurs in the northern (drier) half of the Sudanian region where it is often degraded to riparian woodland (White 1983 p. 105).

Somalia-Masai riparian forest occurs only on the banks of larger rivers such as the Galana, Kiboko, Tana, Uaso Nyiro and Voi rivers of Kenya (riparian forests also occur in Tanzania; White 1983 p. 117).

Since we think that the riverine occurrence of riverine forests is more characteristic than the species composition of these forests, we refer to section 20.3 for information about characteristic species.

### 16.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).



Figure 16.1. Riverine forest at Rusumo along Akagera River (Rwanda). Photograph by E. Fischer (October 1985).



Figure 16.2. Riverine forest dominated by *Cynometra* and *Baphia* species along the Mpanga River Gorge (Kamwenge, Uganda. Photograph by J. Kalema (January 2009).

Table 16. Species composition of Riverine forests (edaphic forest type, fr)

SPECIES	Regional status	Ethiopia	Kenya (forest subtype)	Kenya (woodland subtype)	Malawi	Rwanda	Tanzania	Uganda	Zambia	Coast
<i>Acacia asak</i>		x								
<i>Acacia elatior</i>	Somalia-Masai riparian forest		C	C				f		C
<i>Acacia galpinii</i>	Zambezian deciduous riparian forest				C					
<i>Acacia gerrardii</i>		f	C		f	f	f	x	f	f
<i>Acacia kirkii</i>	Lake Victoria swamp forest		C			x	f	f	f	
<i>Acacia nigrescens</i>					f				C	
<i>Acacia oerfota</i>		f	x				f	C		f
<i>Acacia polyacantha</i>	Zambezian deciduous riparian forest		C	C	x	f	f	f	f	f
<i>Acacia robusta</i>	Somalia-Masai and Zambezian deciduous riparian forest	x	C	f					f	C
<i>Acacia seyal</i>		f	x	C	f		f	f	f	
<i>Acacia sieberiana</i>	Sudanian riparian forest	f	C		x	f	f	f	f	f
<i>Acacia tortilis</i>	Zambezian deciduous riparian forest, along larger seasonal streams in Marsabit district	f	C	C			f	C	f	f
<i>Acacia xanthophloea</i>	Zambezian deciduous riparian forest		C		x					f
<i>Acokanthera oppositifolia</i>			C		f				f	f
<i>Afzelia quanzensis</i>			f		x		f	f	f	C
<i>Albizia glaberrima</i>	Somalia-Masai riparian forest		C	f	x		C	f	x	f
<i>Albizia grandibracteata</i>		x	C			f	f	f		
<i>Albizia petersiana</i>			C		x	f	f	f		f
<i>Albizia saman</i>	(exotic species)		C							f
<i>Albizia schimperiana</i>		f	C		f		f	f	f	
<i>Albizia versicolor</i>	Zambezian deciduous riparian forest		f		x	f	f	f	f	x
<i>Albizia zimmermannii</i>	Somalia-Masai riparian forest		C	f	x				f	
<i>Albizia zygia</i>			C				f	f		
<i>Allophylus abyssinicus</i>		x	C		x	f	f	f	f	
<i>Allophylus africanus</i>		x	x		x	x	f	f	x	
<i>Allophylus rubifolius</i>		f	C		f	f	f	f	f	f
<i>Annona senegalensis</i>		f	C		x	f	f	f	f	f
<i>Anthocleista grandiflora</i>			C		x		f	f		C
<i>Antiaris toxicaria</i>		f	f			f	f	f	f	C
<i>Antidesma venosum</i>		x	C		f		f	f	x	C
<i>Aphania senegalensis</i>	riparian forest in the greater Serengeti region		C	C				f	f	C
<i>Apodytes dimidiata</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	x	f		x	x	f	f	C	f
<i>Baikiaea insignis</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river (dominant)					x	f	f		
<i>Balanites aegyptiaca</i>		f	C			f	f	f	f	
<i>Balanites wilsoniana</i>			f				f	f		C
<i>Berchemia discolor</i>		x	C		x		f	f	f	f
<i>Bersama abyssinica</i>		x	C		f	x	f	f	f	f
<i>Blighia unijugata</i>		x	C		f	x	f	f	f	f
<i>Bombax rhodognaphalon</i>			f		x		f			C
<i>Borassus aethiopum</i>	(palm species)	f	C		D		f	f	f	f
<i>Bretonia salicina</i>	Sudanian and Zambezian evergreen or semi-evergreen riparian forest	C	x		C		f	f	C	C
<i>Bridelia bridelifolia</i>					x	x	x	x		
<i>Bridelia micrantha</i>		x	C		x	C	f	f	C	C
<i>Burttodavaya nyasica</i>					C		f			C
<i>Cadaba farinosa</i>		f	C	C		f	f	f		f
<i>Caesalpinia volkensii</i>			C				f	f		f
<i>Calodendrum capense</i>			C		x		f	f		
<i>Calotropis procera</i>		x	C				f	f		f
<i>Capparis tomentosa</i>		x	C		x	f	f	x	x	f
<i>Carissa spinarum</i>		x	x		f	f	f	x	f	f
<i>Celtis africana</i>		C	C		f	f	f	f	f	x
<i>Clausena anisata</i>		f	C		x	x	f	f	x	f
<i>Combretum imberbe</i>	Zambezian deciduous riparian forest				x				f	f
<i>Cordia africana</i>		f	C		x	x	f	f	f	
<i>Cordia monoica</i>		x	C				f	f		f
<i>Cordia sinensis</i>		x	C	C			f	f	f	f
<i>Cordyla africana</i>	Zambezian deciduous riparian forest		f		C		f		f	f
<i>Craibia brownii</i>			C			f	f	f		f
<i>Crateva adansonii</i>		x	C				f	f		
<i>Crotalaria agatiflora</i>		f	C		f	f	f	f		
<i>Croton macrostachyus</i>		f	C		f	x	f	f	f	
<i>Croton megalocarpus</i>			C		f		f	f	f	
<i>Cussonia spicata</i>			C		f		f	f	f	
<i>Delonix elata</i>		f	f	C			f	C	f	
<i>Diospyros abyssinica</i>		x	C			f	f	f	f	x
<i>Diospyros mespiliformis</i>	Somalia-Masai, Sudanian and Zambezian deciduous riparian forest		C	f	C		C	f	C	C
<i>Diospyros scabra</i>		x	x	C				f		
<i>Dobera glabra</i>	Somalia-Masai riparian forest	f	x	f				f		f
<i>Dombeya buettneri</i>		f				x				
<i>Dombeya kirkii</i>		f	C		x	x	f	f	f	
<i>Dovyalis abyssinica</i>		x	C			f		f	f	
<i>Dovyalis macrocalyx</i>			C		x	x	f	f	f	f
<i>Dracaena steudneri</i>		f	f		x	x	f	f	f	
<i>Ehretia cymosa</i>		x	f		f	x				
<i>Ekebergia capensis</i>	riparian forest in the greater Serengeti region	f	C		x	x	f	f	x	f
<i>Elaeodendron buchananii</i>		f	C		x	f	f	f	f	
<i>Embelia schimperi</i>		x	f		x	x	f	f	x	
<i>Ensete ventricosum</i>		x	f		x	x	f	f	f	
<i>Entada abyssinica</i>		f	C		f	f	f	f	f	
<i>Erythrina excelsa</i>			C				f	f	f	
<i>Erythrophloeum suaveolens</i>	Zambezian evergreen or semi-evergreen riparian forest		f		C		f	f	C	C
<i>Erythroxylum fischeri</i>		x	C				f	f		



SPECIES	Regional status	Ethiopia	Kenya (forest subtype)	Kenya (woodland subtype)	Malawi	Rwanda	Tanzania	Uganda	Zambia	Coast
<i>Euclea divinorum</i>		f	C		x	f	f	f	x	f
<i>Euclea natalensis</i>			C		x		f		f	f
<i>Euclea racemosa</i>		f	f		x	x	f	C	f	f
<i>Eugenia capensis</i>		x	f		f	x	f	f	f	
<i>Faidherbia albida</i>	Zambezian deciduous riparian forest	f	C	C	x		f	x	C	f
<i>Faurea saligna</i>			f		x	f	f	f	C	f
<i>Fernandoo magnifica</i>	Somalia-Masai riparian forest (near coast and endemic to coastal forests)		f				x			f
<i>Ficus exasperata</i>		x	f		x	f	f	f	f	f
<i>Ficus ingens</i>	Somalia-Masai riparian forest	f	C	f	f	x	f	f	f	f
<i>Ficus natalensis</i>			C		f	f	f	f	f	f
<i>Ficus ovata</i>		x	C		f	f	f	f	f	
<i>Ficus sur</i>	Zambezian deciduous riparian forest	x	C		x	f	f	f	C	x
<i>Ficus sycamoros</i>	Somalia-Masai, Sudanian and Zambezian deciduous riparian forest	C	C	f	x	C	C	f	f	C
<i>Ficus thonningii</i>		x	C		f	x	f	f	f	
<i>Ficus vallis-choudae</i>		x	C		x	x	f	f	f	x
<i>Ficus vasta</i>		x	C				f	x	f	
<i>Filicium decipiens</i>		x	C		x		f			
<i>Flacourtia indica</i>		x	f		x	f	f	f	x	f
<i>Flueggea virosa</i>		f	C		f	f	f	f	f	f
<i>Garcinia livingstonei</i>	Somalia-Masai riparian forest (including greater Serengeti region)	x	C	f	x		f	f	C	C
<i>Gardenia ternifolia</i>			f	C			f	f	f	f
<i>Gardenia volkensii</i>		x	C				f	f	x	f
<i>Grewia villosa</i>		f	f	C			f	f	f	f
<i>Harrisonia abyssinica</i>		f	C		x	f	f	f	f	C
<i>Hymenaea verrucosa</i>			f				f			C
<i>Hypericum quartinianum</i>		f	C		f		f	f	f	
<i>Hyphaene compressa</i>	(palm species)	f	C	C			f			C
<i>Hyphaene coriacea</i>	(palm species)		f	C			f			f
<i>Hyphaene petersiana</i>	(palm species)				x		f		C	
<i>Ilex mitis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river; Zambezian swamp forest	x	C		x	f	f	f	C	
<i>Jatropha curcas</i>			C		f		f	f	f	f
<i>Justicia schimperiana</i>		x	x				f			f
<i>Khaya anthotheca</i>	Somalia-Masai and Zambezian evergreen or semi-evergreen riparian forest		x	f	C		C	f	C	C
<i>Kigelia africana</i>	Somalia-Masai and Zambezian deciduous riparian forest	x	C	f	x	C	C	x	f	C
<i>Kigelia moosa</i>			C				f	f		
<i>Landolphia buechananii</i>		x	C		f		f	f	x	
<i>Lannea schweinfurthii</i>		f	x		x	f	f	f	f	f
<i>Lawsonia inermis</i>		f	C	x			f	f		C
<i>Lecaniodiscus fraxinifolius</i>	Somalia-Masai (including greater Serengeti region) and Zambezian deciduous riparian forest	x	C	f	x		f	f	f	C
<i>Leptadenia hastata</i>		f	C							
<i>Maerua decumbens</i>		f	C				f	f		f
<i>Maesa lanceolata</i>		x	f		x	x	f	f	x	
<i>Maesopsis eminii</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river		C		f	f	f	f	f	
<i>Manilkara mochisia</i>	Zambezian deciduous riparian forest		f		x		f		C	f
<i>Markhamia lutea</i>			C			x	f	f		
<i>Maytenus arbutifolia</i>		f	C				f	f	f	
<i>Maytenus senegalensis</i>		f	C		f	f	f	f	x	f
<i>Milicia excelsa</i>		f	f		C	f	f	f		C
<i>Mimusops bagshawei</i>			C			x	f	f		f
<i>Mimusops kummel</i>		C	C		f		f	f		
<i>Mimusops obtusifolia</i>			f		x		f			C
<i>Mimusops zeyheri</i>	Zambezian deciduous riparian forest				f		f		C	
<i>Monodora myristica</i>			C				f	f		
<i>Monopetalanthus richardsiae</i>	Zambezian evergreen or semi-evergreen riparian forest						f		x	
<i>Moringa stenopetala</i>		f	f					C		
<i>Mussaenda arcuata</i>		x	f				f	f		
<i>Myrianthus holstii</i>			C		f	f	f	f	f	f
<i>Newtonia buechananii</i>	Zambezian evergreen or semi-evergreen riparian forest; near streams in Afromontane dry transitional forest		C		C	x	f	f	f	C
<i>Newtonia hildebrandtii</i>	Somalia-Masai and Zambezian deciduous riparian forest		C	f	x		f			
<i>Oncoba spinosa</i>		x	C		x		f	f	x	
<i>Oreobambos buchwaldii</i>	(bamboo species indigenous to Africa)		C		x		f	f	f	
<i>Oxystigma msao</i>			C				f			x
<i>Parinari excelsa</i>					x	f	f	f	C	C
<i>Parkia filicoidea</i>	Somalia-Masai and Zambezian evergreen or semi-evergreen riparian forest (Lake Victoria swamp forest)		x	f	C		C	f	f	C
<i>Parkinsonia aculeata</i>			C							
<i>Pavetta oliveriana</i>		x	C			x	f	f		
<i>Phoenix dactylifera</i>			x				f			f
<i>Phoenix reclinata</i>	Lake Victoria swamp forest; Zanzibar-Inhambane swamp forest; palm species	C	C		x	x	f	f	x	C
<i>Phytolacca dodecandra</i>		f	C		f	x	f	f	f	
<i>Piliostigma thonningii</i>		f	f		x	f	f	f	f	C
<i>Pittosporum viridiflorum</i>		f	C		x	x	f	f	f	
<i>Polyscias fulva</i>			C		f	f	f	f	f	
<i>Populus ilicifolia</i>	Somalia-Masai riparian forest		C	f			f			C
<i>Premna schimperii</i>		x					f	f		
<i>Prunus africana</i>		f	C		x	f	f	f	f	
<i>Pseudospondias microcarpa</i>	Lake Victoria swamp forest; Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river		C			x	f	f	f	
<i>Psychotria mahonii</i>			C		x	f	f	f	f	

SPECIES	Regional status	Ethiopia	Kenya (forest subtype)	Kenya (woodland subtype)	Malawi	Rwanda	Tanzania	Uganda	Zambia	Coast
<i>Pterocarpus tinctorius</i>					x		f		f	C
<i>Raphia farinifera</i>	Lake Victoria swamp forest (palm species)		C		x		f	f	C	f
<i>Rauvolfia caffra</i>			C		f		f	f	x	f
<i>Rhoicissus revollii</i>		x	C		f	f	f	f	f	f
<i>Rhus longipes</i>		x	C		f	f	f	f	x	f
<i>Ritchiea albersii</i>		f	C			x	f	f	f	
<i>Rothmannia urcelliformis</i>		x	C		f		f	f	f	
<i>Saba comorensis</i>		x	C		x					
<i>Salvadora persica</i>		x	C	C	f		f	f	f	f
<i>Sclerocarya birrea</i>		f	C		f		f	f	f	f
<i>Scutia myrtina</i>		x	C		f	x	f	f	x	
<i>Senna didymobotrya</i>		f	C		f	f	f	f	f	
<i>Senna septemtrionalis</i>			C		f	f	f	f	f	
<i>Sesbania macrantha</i>			C		f	f	f	f	f	
<i>Sesbania sesban</i>		x	C		x	f	f	f	f	x
<i>Shirakiopsis elliptica</i>		x	C		C	x	f	f	x	
<i>Sideroxylon inerme</i>			C				f			f
<i>Smilax anceps</i>		f	C			f	f	f	x	
<i>Solanecio mannii</i>		x	C		f	f	f	f	x	
<i>Solanum aculeastrum</i>			C		f	f	f	f		
<i>Sorindeia madagascariensis</i>			C		C		f			C
<i>Spathodea campanulata</i>			C			x	f	f		
<i>Spirostachys venenifera</i>			C							C
<i>Steganotaenia araliacea</i>		f	C		f	f	f	f	f	
<i>Sterculia appendiculata</i>			C		C		f			C
<i>Strychnos henningsii</i>		f	C		x		f	f	f	x
<i>Strychnos mitis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	x	C		f		f	f		f
<i>Strychnos potatorum</i>	Zambezian deciduous riparian forest				x	f				C
<i>Strychnos spinosa</i>		x	f		x	f	f	f	f	f
<i>Suregada procera</i>		f	C		f		f	f	f	
<i>Synsepalum brevipes</i>			C		x		f	f	x	C
<i>Syzygium cordatum</i>	Lake Victoria swamp forest; Zambezian swamp forest		C		x	f	f	f	C	f
<i>Syzygium guineense</i>	Sudanian riparian forest ( <i>Syzygium guineense</i> ssp. <i>guineense</i> )		C	C	C	x	f	f	C	C
<i>Syzygium owariense</i>	Zambezian swamp forest				C		f	f	f	
<i>Tamarindus indica</i>	Somalia-Masai and Sudanian riparian forest	C	C	C	x		C	f	x	f
<i>Tamarix aphylla</i>		x	x							
<i>Tamarix nilotica</i>			C				f			
<i>Tarenna graveolens</i>		f	C			f	f	f		
<i>Terminalia brownii</i>		f	C				f	x		f
<i>Terminalia prunioides</i>		f	C				f		f	f
<i>Terminalia sambesiaca</i>	Somalia-Masai riparian forest		x	f	C		f		f	C
<i>Tetradenia riparia</i>		x	f			f			x	
<i>Trema orientalis</i>		x	C		f	C	f	f	x	f
<i>Trichilia dregeana</i>			C		f		f	f	f	f
<i>Trichilia emetica</i>	Somalia-Masai and Zambezian deciduous riparian forest	C	C	f	C		C	f	C	C
<i>Uvaria scheffleri</i>			C				f	f		f
<i>Vangueria apiculata</i>		x	C		f	f	f	f	f	
<i>Vangueria infausta</i>			C		f	f	f	f	f	f
<i>Vangueria madagascariensis</i>		f	C		f		f	f		f
<i>Vepris nobilis</i>		x	C		f	x	f	f	f	f
<i>Vernonia amygdalina</i>		x	C		x	x	f	f	f	
<i>Vernonia myriantha</i>		x	f		x	f	f	f	f	
<i>Vitex doniana</i>	Sudanian riparian forest	f	f		x	f	f	f	x	f
<i>Warburgia ugandensis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	C		f		f	f		
<i>Woodfordia uniflora</i>		x	C					f		
<i>Xanthocercis zambesiaca</i>	Zambezian deciduous riparian forest				x				f	
<i>Xylopia parviflora</i>		f	f		x		f	f	f	C
<i>Zanha galungensis</i>		x	f		f	x	f	f	f	f
<i>Zanthoxylum gillettii</i>		x	f			x	f	f		
<i>Ziziphus abyssinica</i>		f	f		x	f	f	x	f	f
<i>Ziziphus mauritiana</i>		x	C		f		f	f	x	f
<i>Ziziphus mucronata</i>		x	C		f	f	f	x	x	f
<i>Ziziphus pubescens</i>		x	C		x		f	f	f	f
<i>Ziziphus spina-christi</i>		f	C				f	f		f

## 17. Swamp forest (edaphic forest type, fs)

### 17.1. Description

In analogy with riverine forests (fr), we decided not to map floristic variants of riverine forests although White (1983) treated riverine forests separately within the descriptions of regional centres of endemism. Actually, it was in most situations not practical to map swamp forests.

In the wetter parts of the Zambezian region (with rainfall above 1000 mm), permanent swamp forest occurs around springs at the sources of tributary streams. Swamp forests also occurs along watercourses (*i.e.* also as subtype of riverine forest [fr]) where water movement is locally sluggish. In the latter situation, swamp forests merge into other types of riparian forest in which the water table is at some distance below the surface for at least part of the year (White 1983 p. 91).

Although White (1983) lists a heading within the description of the Sudanian region as “Sudanian swamp forest and riparian forest”, he does not give a specific description of Sudanian swamp forest (White 1983 pp. 103 - 104).

Swamp forests dominated by species that are widespread in tropical Africa occur extensively on the shores of Lake Victoria and elsewhere in the Lake Victoria region. On alluvial deposits of the Kagera river (on the western shore of Lake Victoria), a unique swamp forest occurs that is composed almost in equal proportions of lowland (especially Guineo-Congolian) and Afromontane species and that is dominated by *Baikiaea insignis* (a Guineo-Congolian species) and by *Podocarpus usambarensis* var. *dawei* (an Afromontane species; White 1983 p. 181).

Fresh-water swamp forest is of restricted occurrence in the Zanzibar-Inhambane region. *Barringtonia racemosa*, a species associated with mangroves (M), often occurs in swamp forests immediately behind the mangrove zone and extends upstream for considerable distances (White 1983 p. 188).

### 17.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 17. Species composition of Swamp forest (edaphic forest type, fs)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	Uganda (fsBU subtype)	Uganda (fsrU subtype)	Zambia	Coast
<i>Acacia kirkii</i>	Lake Victoria swamp forest		f		f	f	f	C	f	
<i>Acrostichum aureum</i>	Zanzibari-Inhambane swamp forest (fern species)					f				x
<i>Albizia glaberrima</i>	Somalia-Masai riparian forest		f	f		f	x	f	f	f
<i>Alchornea hirtella</i>			f	f	f	f	x	f	x	
<i>Anthocleista grandiflora</i>			C	x		f	f	f		x
<i>Anthocleista schweinfurthii</i>	Lake Victoria swamp forest	f			f	f	x	f	C	
<i>Antidesma venosum</i>		C	f	f		f	f	f	f	f
<i>Apodytes dimidiata</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	f	f	f	f	x	f	f	f
<i>Aporrhiza nitida</i>	Zambezian swamp forest			f					x	
<i>Baikiaea insignis</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river (dominant)				f	f	D	f		
<i>Barringtonia racemosa</i>	Zanzibar-Inhambane swamp forest, also mangrove associated species		f			f				x
<i>Beilschmiedia ugandensis</i>			f			f	x	f	C	
<i>Blighia unijugata</i>		f	f	f	C	f	x	C	f	f
<i>Bridelia micrantha</i>		f	f	f	f	f	x	f	x	f
<i>Canarium schweinfurthii</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river	f				f	x	f	f	
<i>Celtis africana</i>		f		f	C	f	f	f	f	f
<i>Celtis gomphophylla</i>		f	f	f	f	C	f	C	f	f
<i>Clausena anisata</i>		f	f	f	f	f	x	f	x	f
<i>Combretum imberbe</i>	Zambezian deciduous riparian forest			f		f			f	f
<i>Cordia africana</i>		f	f	f	C	f	x	f	f	
<i>Cordyla africana</i>	Zambezian deciduous riparian forest		C			C			f	f
<i>Craterispermum laurinum</i>	Zambezian swamp forest		f						x	
<i>Croton megalocarpus</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river		f	f	f	f	x	f	f	
<i>Diospyros mespiliformis</i>	Somalia-Masai, Sudanian and Zambezian deciduous riparian forest	f	C	f		f	f	f	f	f
<i>Dombeya rotundifolia</i>		f	f	f	C		f	f	f	
<i>Dracaena camerooniana</i>	Zambezian swamp forest								x	
<i>Ekebergia capensis</i>	riparian forest in the greater Serengeti region	f	f	f	C	f	x	f	x	f
<i>Elaeis guineensis</i>	Zanzibar-Inhambane swamp forest (palm species)		f	f		f	f	f		x
<i>Erythrina abyssinica</i>		f	f	f	x	f	f	f	f	f
<i>Erythrina excelsa</i>	Lake Victoria swamp forest		f			f	x	f	f	
<i>Erythrophloeum suaveolens</i>	Zambezian evergreen or semi-evergreen riparian forest		f	f		C	f	f	f	f
<i>Erythroxylum fischeri</i>			C			f	x	f		
<i>Euclea divinorum</i>		f	f	f	C	f	f	f	f	f
<i>Faidherbia albida</i>		f	C	f	f	f	f	f	f	f
<i>Ficalhoa laurifolia</i>				f	f	f	f	f	C	
<i>Ficus natalensis</i>			C	f	f	f	x	f	f	f
<i>Ficus sur</i>	Zambezian deciduous riparian forest	f	C	f	f	f	x	f	C	x
<i>Ficus sycomorus</i>	Somalia-Masai, Sudanian and Zambezian deciduous riparian forest	f	x	f	x	f	x	f	f	x
<i>Ficus trichopoda</i>	Lake Victoria swamp forest; Zambezian swamp forest			x	C	f	f	f	C	
<i>Ficus vallis-choudae</i>		f	f	f	C	f	f	f	f	f
<i>Flueggea virosa</i>		f	f	f	f	f	x	x	f	f
<i>Funtumia africana</i>			C	f		f	x	f		f
<i>Garcinia smeathmannii</i>	Zambezian swamp forest			f		f			x	
<i>Gardenia imperialis</i>	Zambezian swamp forest			f		f	f	f	x	
<i>Hallea stipulosa</i>	Lake Victoria swamp forest; Zambezian swamp forest			x		x	f	f	C	
<i>Hibiscus tiliaceus</i>	Zanzibar-Inhambane swamp forest, also mangrove associated species		x			f				x
<i>Ilex mitis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river; Zambezian swamp forest	f	f	f	f	f	C	f	C	
<i>Khaya anthotheca</i>	Somalia-Masai and Zambezian evergreen or semi-evergreen riparian forest		f	f		C	f	f	f	f
<i>Kigelia africana</i>	Somalia-Masai and Zambezian deciduous riparian forest		f	f	f	f	x	C	f	f
<i>Klainedoxa gabonensis</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river					f	x	f	f	
<i>Lannea schweinfurthii</i>			f	f	C	f	f	f	f	f
<i>Lecaniodiscus fraxinifolius</i>	Somalia-Masai (including greater Serengeti region) and Zambezian deciduous riparian forest		f	f		f	x	f	f	f
<i>Macaranga monandra</i>	Lake Victoria swamp forest					f	x	f		
<i>Macaranga schweinfurthii</i>	Lake Victoria swamp forest		C		x	f	x	f	f	
<i>Macaranga spinosa</i>	Lake Victoria swamp forest					C				
<i>Maesa lanceolata</i>		f	f	f	f	f	x	f	x	
<i>Maesopsis eminii</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river		f		f	f	x	f	f	
<i>Musanga cecropioides</i>	Lake Victoria swamp forest					x	f	f		
<i>Newtonia buchananii</i>	Zambezian evergreen or semi-evergreen riparian forest; near streams in Afromontane dry transitional forest		C	f	f	f	f	f	f	f
<i>Parinari excelsa</i>				f	f	f	x	f	C	f

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	Uganda (fsbU subtype)	Uganda (fsrU subtype)	Zambia	Coast
<i>Parkia filicoidea</i>	Lake Victoria swamp forest (also Somalia-Masai and Zambezan evergreen or semi-evergreen riparian forest)		C	f		f	x	f	f	f
<i>Peddiea fischeri</i>			f		f	f	x	f	x	
<i>Phoenix reclinata</i>	Lake Victoria swamp forest; Zanzibar-Inhambane swamp forest; palm species	C	f	x	f	f	f	C	x	x
<i>Podocarpus falcatus</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	f	f	f	f	f	f		
<i>Podocarpus latifolius</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river		f	f	x	f	D	f	f	
<i>Podocarpus usambarensis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river (dominant [ <i>Podocarpus usambarensis</i> var. <i>dawei</i> ])		f			f	D	f		
<i>Pseudospondias microcarpa</i>	Lake Victoria swamp forest; Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river		C		f	f	x	f	f	
<i>Psychotria mahonii</i>			C	f	f	f	x	f	f	
<i>Psychotria peduncularis</i>	Zambezan swamp forest		f	f	x	f	f	f	x	
<i>Pterocarpus tinctorius</i>				f		C			f	f
<i>Pycnanthus angolensis</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river					f	x	f	f	
<i>Raphia farinifera</i>	Lake Victoria swamp forest (palm species)		C	x		f	x	f	C	x
<i>Rauvolfia caffra</i>			f	f		f	x	D	C	f
<i>Ritchiea albersii</i>		f	f		C	f	x	f	f	
<i>Rothmannia urcelliformis</i>		f	f	f		f	x	x	f	
<i>Schrebera arborea</i>							x	C		
<i>Scutia myrtina</i>		f	f	f	C	f	x	f	x	
<i>Shirakiopsis elliptica</i>		f	f	f	C	f	x	f	C	
<i>Sorindeia madagascariensis</i>			C	f		f				x
<i>Spondianthus preussii</i>	Lake Victoria swamp forest					f	C	f		
<i>Sterculia tragacantha</i>					f	f			C	
<i>Strombosia scheffleri</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river		f	f	f	f	x	f		f
<i>Strychnos mitis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	f	f		f	x	f		f
<i>Symphonia globulifera</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river				f	f	x	f	f	
<i>Syzygium cordatum</i>	Lake Victoria swamp forest; Zambezan swamp forest		f	D	C	f	f	x	C	f
<i>Syzygium guineense</i>	Sudanian riparian forest ( <i>Syzygium guineense</i> ssp. <i>guineense</i> )	C	f	f	x	f	x	f	f	f
<i>Syzygium owariense</i>	Zambezan swamp forest			D		f	f	f	C	
<i>Terminalia sambesiaca</i>	Somalia-Masai riparian forest		f	f		C			f	f
<i>Tetrapleura tetraptera</i>	Guineo-congolian species in forests on alluvial deposits at the mouth of the Kagera river		f				x	f		f
<i>Trichocladus ellipticus</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	f	f	f	f	x	f	f	
<i>Typhonodorum lindleyanum</i>	Zanzibar-Inhambane swamp forest					f				x
<i>Uapaca guineensis</i>	Lake Victoria swamp forest; Zambezan swamp forest			f		f			C	f
<i>Vangueria madagascariensis</i>		f	C	f		f	f	f	f	f
<i>Vepris nobilis</i>		f	f	f	C	f	x	f	f	f
<i>Vitex doniana</i>	Sudanian riparian forest	f	f	f	f	f	f	f	f	x
<i>Voacanga thouarsii</i>	Lake Victoria swamp forest; Zanzibar-Inhambane swamp forest		C	f		x	f	f	x	x
<i>Warburgia ugandensis</i>	Afromontane species in forests on alluvial deposits at the mouth of the Kagera river	f	f	f		f	x	f		
<i>Xylopia aethiopica</i>	Zambezan swamp forest		f			f	x	f	C	f
<i>Xylopia rubescens</i>	Zambezan swamp forest					f	f	f	C	
<i>Ziziphus pubescens</i>		f	C	f		f	f	f	f	f



## 18. *Combretum* wooded grassland (Wc)

### 18.1. Description

Trapnell and Langdale-Brown (1972 p. 133) describing *Combretum* wooded grasslands of Kenya, Tanzania and Uganda mention that various broad-leaved *Combretum* species (the most general species being ***Combretum adenogonium*** [synonym: *Combretum ghasalense*], ***Combretum collinum*** [synonym: *Combretum binderianum*], *Combretum molle* and *Combretum zeyheri*) are associated with larger-leaved species of *Terminalia* (another species of the Combretaceae botanical family)<sup>6</sup> in wetter areas - especially ***Terminalia glaucescens*** and ***Terminalia mollis***. In drier areas, *Combretum* species are associated with smaller-leaved *Terminalia* species: ***Terminalia brownii*** in Kenya and Uganda and *Terminalia sericea* in the “monsoon sector” of Tanzania (i.e. areas with a one-season summer rainy season typically occupied by miombo woodland [Wm]). These authors further mentioned that *Combretum* wooded grasslands is the major East African wooded grassland vegetation type.

White (1983) does not refer to *Combretum* or *Combretum-Terminalia* vegetation in the main descriptions of the Zambezan, Somalia-Masai, Sudanian, Afromontane, Lake Victoria or Zanzibar-Inhambane regional centres of endemism.<sup>7</sup> However, in the description of the greater Serengeti region, White (1983) describes *Combretum-Terminalia* secondary wooded grassland as a vegetation type with an open overstorey that is dominated by ***Combretum molle*** (10 - 13 m) and ***Terminalia mollis*** (15 -17 m). This vegetation type is a fire climax community that has replaced dry evergreen forest on ridges tops and upper slopes in the northern part of the Serengeti national park (White 1983 p. 121). ***Combretum molle*** woodland is probably a fire-induced vegetation type that has replaced evergreen bushland (Be) or scrub forest on wetter upland areas of Marsabit district (White 1983 p. 121). “Ethiopian undifferentiated woodland” as described by White (1983 p. 107) is virtually equivalent to *Combretum-Terminalia* woodland and wooded grassland described in the atlas of potential natural vegetation types of Ethiopia (Friis *et al.* 2010 p. 170).

### 18.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, “x” indicates that the species is expected to be present, “C” indicates that the species was identified as characteristic species and “f” indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

6: Lind and Morrison (1974 p. 90) use the name of “Combretaceous wooded grassland and woodland” because the common occurrence of *Combretum* and *Terminalia*. *Terminalia* is similar in appearance to *Combretum*, but *Terminalia* can be recognized from its two-winged woody fruits whereas *Combretum* is characterized by four-winged woody fruits. These authors (p. 81) make the distinction between woodland and wooded grassland vegetation types with predominantly compound-leaved trees (miombo woodland and Acacia woodland) and vegetation with predominantly simple-leaved trees (Combretaceous woodland and wooded grassland, Vitellaria woodland and wooded grassland and Borassus palm grassland

7: This is probably because in many cases, these vegetation types are transitional or secondary (J. Timberlake, pers. comm.)

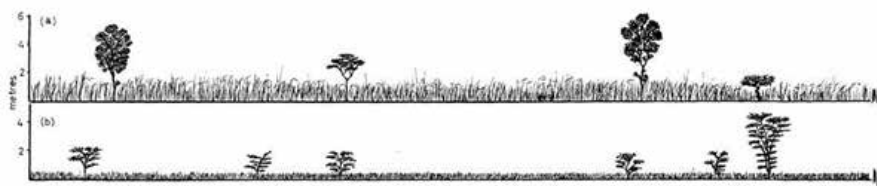


Figure 18.1. This type of *Combretum* wooded grassland vegetation was originally described as “tall *Hyparrhenia* – *Combretum* wooded grassland”. Note that *Hyparrhenia* is a genus of grass species. Pratt *et al.* (1966, Fig. 5a). Image obtained from URL: <http://www.jstor.org/stable/2401259>.



Figure 18.2. *Combretum* – *Terminalia* woodland and wooded grassland on stony soil derived from the basement complex at the foothills of the western escarpment near Bumbadi (Ethiopia). The palm species *Hyphaene thebaica* can be seen in the foreground. Altitude approximately 750 m. Photograph by I. Friis and Sebsebe Demissew (October 2008). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig. 18A. 2010.



Figure 18.3. *Combretum* – *Terminalia* woodland and wooded grassland with tall underground of grasses (mainly *Hyparrhenia* species) on rocky outcrops east of Kurmuk (Ethiopia). Altitude approximately 1100 m. Photograph by I. Friis and Sebsebe Demissew (October 1998). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig. 18B. 2010.

Table 18. Species composition for *Combretum* wooded grassland (Wc)

SPECIES	Regional status	Ethiopia	dry Combretum (Kenya)	dry Combretum (Uganda)	moist Combretum (Kenya)	moist Combretum (Uganda)	Wacu (Uganda subtype)
<i>Acacia hockii</i>	characteristic species for Sudanian undifferentiated woodland	C	x	C	x	f	x
<i>Acacia nilotica</i>	characteristic species for Sudanian undifferentiated woodland	f	x	x			
<i>Acacia polyacantha</i>	characteristic species for Sudanian undifferentiated woodland	x	x	x	x	x	x
<i>Acacia senegal</i>	characteristic species for Sudanian undifferentiated woodland	x	x	x			
<i>Acacia seyal</i>	characteristic species for Sudanian undifferentiated woodland	x	x	C	x	f	
<i>Acacia sieberiana</i>	characteristic species for Sudanian undifferentiated woodland	x	f	x	x	f	x
<i>Annona senegalensis</i>	characteristic species for Sudanian undifferentiated woodland	x	x	C	C	x	x
<i>Anogeissus leiocarpa</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C					
<i>Balanites aegyptiaca</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C	x	C	x	f	
<i>Boscia salicifolia</i>	characteristic species for Sudanian undifferentiated woodland	f	x	x			
<i>Boswellia papyrifera</i>	characteristic species for Ethiopian undifferentiated woodland	C	f	C			
<i>Combretum adenogonium</i>	characteristic species for Sudanian undifferentiated woodland	C	x	C	C	f	
<i>Combretum collinum</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C	C	C	C	x	C
<i>Combretum hartmannianum</i>	characteristic species for Ethiopian undifferentiated woodland	C					
<i>Combretum molle</i>	characteristic species for Sudanian undifferentiated woodland	C	C	C	C	C	C
<i>Commiphora africana</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	f	x	C			
<i>Crossopteryx febrifuga</i>	characteristic species for Sudanian undifferentiated woodland	x	f	f			
<i>Cussonia arborea</i>	characteristic species for Sudanian undifferentiated woodland	x	x	x	x	f	
<i>Dalbergia melanoxylon</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C	x	C			
<i>Dichrostachys cinerea</i>	characteristic species for Sudanian undifferentiated woodland	x	x	f	x	f	
<i>Diospyros mespiliformis</i>	characteristic species for Sudanian undifferentiated woodland	x	x	f			
<i>Ekebergia capensis</i>	characteristic species for Sudanian undifferentiated woodland	f	f	x		f	
<i>Erythrina abyssinica</i>	characteristic species for Ethiopian undifferentiated woodland	x	x	x	x	x	x
<i>Faurea saligna</i>	characteristic species for Sudanian undifferentiated woodland		C	f	x	f	
<i>Ficus glumosa</i>	characteristic species for Sudanian undifferentiated woodland	x	x	f	x	f	
<i>Ficus sycomorus</i>	characteristic species for Sudanian undifferentiated woodland	f	x	f	x	f	
<i>Gardenia ternifolia</i>	characteristic species for Ethiopian undifferentiated woodland	x	x	x	x	f	
<i>Lannea humilis</i>	characteristic species for Sudanian undifferentiated woodland	f	f	C			
<i>Lannea schimperii</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	x	x	C	x	f	
<i>Parinari curatellifolia</i>	characteristic species for Sudanian undifferentiated woodland		x	f	C	f	
<i>Philenoptera laxiflora</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C		C			
<i>Piliostigma thonningii</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C	x	C	C	x	
<i>Pseudocedrela kotschy</i>	characteristic (Sudanian woodland and Guineo-Congolian secondary wooded grassland)	x		C			
<i>Sclerocarya birrea</i>	characteristic species for Sudanian undifferentiated woodland	C	x	C			
<i>Steganotaenia araliacea</i>	characteristic species for Sudanian undifferentiated woodland	x	x	x	x	f	
<i>Stereospermum kunthianum</i>	characteristic species for Ethiopian undifferentiated woodland and for Sudanian undifferentiated woodland	C	x	C	x	x	
<i>Syzygium guineense</i>	characteristic species for Sudanian woodland [ <i>Syzygium guineense</i> ssp. <i>guineense</i> ]	x	f	x	x	f	
<i>Tamarindus indica</i>	characteristic species for Sudanian undifferentiated woodland	f	x	x	x	x	
<i>Terminalia brownii</i>	characteristic species for Ethiopian undifferentiated woodland	C	C	C	x	f	
<i>Terminalia laxiflora</i>	characteristic species for Sudanian undifferentiated woodland	C		f			
<i>Terminalia schimperiana</i>	characteristic species for Sudanian undifferentiated woodland	f	C		C	x	
<i>Trichilia emetica</i>	characteristic species for Sudanian undifferentiated woodland	f	x	f	x	f	
<i>Vitellaria paradoxa</i>	characteristic species for Sudanian undifferentiated woodland and Sudanian secondary grassland	x		x			
<i>Vitex doniana</i>	characteristic species for Sudanian undifferentiated woodland	C	f	f	C	f	
<i>Ziziphus abyssinica</i>	characteristic species for Sudanian undifferentiated woodland	x	x	C	x	f	
<i>Ziziphus mauritiana</i>	characteristic species for Sudanian undifferentiated woodland	f	x	f			
<i>Ziziphus mucronata</i>	characteristic species for Sudanian undifferentiated woodland	x	x	f	x	f	
<i>Acacia brevispica</i>		f	x	f	x	f	
<i>Acacia drepanolobium</i>		x	x	f	x	f	
<i>Acacia gerrardii</i>	not characteristic	x	x	x	x	f	
<i>Acacia tortilis</i>		x	x	f			
<i>Acokanthera oppositifolia</i>			x		x		
<i>Acokanthera schimperii</i>		f	x	f	x	f	
<i>Adansonia digitata</i>		C	x				
<i>Albizia anthelmintica</i>		x	x	C			
<i>Albizia coriaria</i>		x	f	C	x	x	x
<i>Albizia malacophylla</i>		x		x			
<i>Albizia zygia</i>			f	C	x	C	C
<i>Allophylus africanus</i>		x	f	f	x	f	
<i>Allophylus rubifolius</i>		x	x	f	x		
<i>Antidesma venosum</i>		f	x	f	x	f	
<i>Apodytes dimidiata</i>		f	x	f	x	f	



SPECIES	Regional status	Ethiopia	dry	Combretum (Kenya)	dry	Combretum (Uganda)	moist	Combretum (Kenya)	moist	Combretum (Uganda)	WacU (Uganda subtype)
<i>Borassus aethiopum</i>		x	f	f	x	f					
<i>Bridelia micrantha</i>		f	x	f	x	f					
<i>Bridelia scleroneura</i>		x	x	C	x	x					x
<i>Calotropis procera</i>		f	x	f	x	f					
<i>Capparis tomentosa</i>		f	x	f	x	f					
<i>Carissa spinarum</i>		f	x	f	x	f					
<i>Catha edulis</i>		f	x	f	x	f					
<i>Clausena anisata</i>		f	x	f	x	f					
<i>Clerodendrum myricoides</i>		x	x	f	x	f					
<i>Combretum aculeatum</i> (Combretaceae)		f	x	f							
<i>Combretum schumannii</i> (Combretaceae)			x								
<i>Combretum zeyheri</i> (Combretaceae)			C		x						
<i>Commiphora habessinica</i>		f	x	x							
<i>Cordia africana</i>		x	x	f							
<i>Cordia monoica</i>		f	x	f	x	f					
<i>Croton macrostachyus</i>		x	x	x	x	f					
<i>Cussonia holstii</i>		f	x	f	x	f					
<i>Dodonaea viscosa</i>		f	x	f	x	f					
<i>Dombeya buettneri</i>		x									
<i>Dombeya rotundifolia</i>		f	x	C	x	f					
<i>Elaeodendron buchananii</i>		f	x	f	x	f					
<i>Entada abyssinica</i>		x	f	x	x	f					
<i>Erythrina burtii</i>			x								
<i>Euclea divinorum</i>		f	x	f	x	f					
<i>Euclea racemosa</i>		f	x	x	C	f					
<i>Euphorbia candelabrum</i>		x	x	f	x	f					
<i>Euphorbia tirucalli</i>		f	x	f	x	f					
<i>Faurea rochetiana</i>		x	f	f	C	f					
<i>Ficus natalensis</i>			x	f	x	f					
<i>Flacourtia indica</i>		f	x	f	x	f					
<i>Flueggea virosa</i>		x	x	f	x	f					
<i>Gardenia volkensii</i>		x	x	f	x	f					
<i>Grewia bicolor</i>		x	x	f	x	f					
<i>Grewia mollis</i>		x	x	f	x	f					
<i>Grewia similis</i>		f	x	f	x	f					
<i>Grewia tembensis</i>		f	x		x						
<i>Grewia villosa</i>		f	x	f	x	f					
<i>Harrisonia abyssinica</i>		x	x	C	x	f					
<i>Indigofera swaziensis</i>			x	f	x	f					
<i>Jatropha curcas</i>			x	f	x	f					
<i>Kigelia africana</i>		f	x	x	x	f					
<i>Lannea barteri</i>		C		x							C
<i>Lannea fulva</i>					x	f					
<i>Lannea schweinfurthii</i>		x	x	f	x	f					
<i>Lannea triphylla</i>		f	x	C							
<i>Lecaniodiscus fraxinifolius</i>		f	x	f	x	f					
<i>Lippia kituiensis</i>			x		x						
<i>Maerua decumbens</i>		f	x	f	x	f					
<i>Markhamia lutea</i>					x	x					
<i>Maytenus arbutifolia</i>		f	x	f	x	f					
<i>Maytenus senegalensis</i> not characteristic		x	x	C	C	f					
<i>Maytenus undata</i>		f	x	f	x	f					
<i>Meyna tetraphylla</i>		x	x	f							
<i>Milicia excelsa</i>		f	x	f	x	x					
<i>Mussaenda arcuata</i>					x	f					
<i>Oncoba spinosa</i>		x	x	f	x	f					
<i>Ormocarpum kirkii</i>			x								
<i>Ormocarpum trichocarpum</i>		f	x	x	x	f					
<i>Oxytenanthera abyssinica</i> (lowland bamboo species)		C		C							
<i>Ozoroa insignis</i>		x	x	C	x	x					
<i>Pappea capensis</i>		x	x	x	x	f					
<i>Pavetta crassipes</i>		x	x	x	x	f					
<i>Pavetta oliveriana</i>		x	f	f	x	f					
<i>Phytolacca dodecandra</i>		f	x	f	x	f					
<i>Pittosporum viridiflorum</i>		f	x	f	x	f					
<i>Plectranthus barbatus</i>		f	x	f	x	f					
<i>Premna resinosa</i>		f	x	f	x	f					
<i>Psydrax schimperiana</i>		x	x	f	x	f					
<i>Pterolobium stellatum</i>		f	x	f	x	f					
<i>Rauvolfia caffra</i>			x	f	x	f					
<i>Rhamnus staddo</i>		f	x	f	x	f					
<i>Rhoicissus revollii</i>		x	x	f	x	f					
<i>Rhoicissus tridentata</i>		x	x	f	x	f					

SPECIES	Regional status	Ethiopia					
			dry Combretum (Kenya)	dry Combretum (Uganda)	moist Combretum (Kenya)	moist Combretum (Uganda)	Wacu (Uganda subtype)
<i>Rhus longipes</i>		x	x	f	x	f	
<i>Rhus natalensis</i>		x	x	C	x	f	
<i>Rhus tenuinervis</i>		x	x				
<i>Rhus vulgaris</i>		x	x	f	x	f	
<i>Rubus volkensii</i>		f	x	f	x	f	
<i>Salvadora persica</i>		f	x	f	x	f	
<i>Sarcocephalus latifolius</i>	not characteristic	x	f	f	x	f	
<i>Scutia myrtina</i>		f	x	f	x	f	
<i>Securidaca longipedunculata</i>	not characteristic	x	x	x	x	f	
<i>Senna didymobotrya</i>		f	x	f	x	f	
<i>Senna septemtrionalis</i>			x	f	x	f	
<i>Senna singueana</i>		f	x	x	x	f	
<i>Sterculia africana</i>		x	x				
<i>Strychnos henningsii</i>		x	x	f	x	f	
<i>Strychnos innocua</i>	not characteristic	x	f	C			x
<i>Strychnos spinosa</i>	not characteristic	x	x	f	x	f	
<i>Tarenna graveolens</i>		f	x	f	x	f	
<i>Tephrosia vogelii</i>			x	f	x	f	
<i>Terminalia mollis</i>	(Combretaceae)		x	x	C	f	
<i>Terminalia prunioides</i>	(Combretaceae)	f	x				
<i>Terminalia spinosa</i>	(Combretaceae)	f	x	C			
<i>Tetradenia riparia</i>		f	x		x		
<i>Vangueria apiculata</i>		f	x	f	x	f	
<i>Vangueria infausta</i>			x	f	x	f	
<i>Vangueria madagascariensis</i>		f	x	f	x	f	
<i>Vepris nobilis</i>		f	x	f	x	f	
<i>Warburgia ugandensis</i>		f	x	f	x	f	
<i>Ximenia americana</i>		x	x	x	x	f	
<i>Zanthoxylum chalybeum</i>		f	x	f	x	f	
<i>Zanthoxylum usambarense</i>		f	x		x		
<i>Ziziphus pubescens</i>		f	x	f	x	f	



## 19. *Acacia-Commiphora* deciduous wooded grassland (synonym: deciduous wooded grassland, Wd)

### 19.1. Description

Throughout volumes 2 to 5, we use “deciduous wooded grassland (Wd)” as a synonym of “*Acacia-Commiphora* deciduous wooded grassland (Wd)”.

Although grasses are inconspicuous in typical Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bd), *Acacia-Commiphora* deciduous wooded grassland communities exist such as the wooded grasslands from the greater Serengeti region (Tanzania). The wooded grasslands from the greater Serengeti region are different from typical deciduous bushland communities (Bd) by the insignificance of bushy plants other than *Acacia* and *Commiphora* and by the relative abundance of grasses (especially perennial grass species). The extent to which these features might be a result from prevalent grass fires or a large ungulate population is uncertain, but rainfall is too high in most places of the greater Serengeti region for typical deciduous bushland to occur (except along the drier eastern fringe; White 1983 pp. 125 and 128).

Somalia-Masai deciduous wooded grassland is the most extensive woody vegetation type (88 percent) in the Serengeti National Park. It consists of a single open stratum of *Acacia* or *Commiphora* thorn trees mostly 3 to 7 m high, but 9 to 20 m in a few species. This vegetation is wooded grassland since canopy cover is less than 40 percent in most places. The grass stratum is 0.5 to 1.5 m high and is dominated by *Digitaria macroblephara*, *Eustachys paspaloides*, *Pennisetum mezianum* (on poorly drained soils) and *Themeda triandra*.

The wooded grasslands of the greater Serengeti region can be mapped by one mapping unit that is dominated by *Commiphora schimperi* and 38 mapping units that contain one or several of 11 *Acacia* species (including *Acacia drepanolobium*, *Acacia gerrardii*, *Acacia hockii*, *Acacia nilotica*, *Acacia robusta*, *Acacia senegal*, *Acacia seyal*, *Acacia sieberiana*, *Acacia tortilis*, *Acacia polyacantha* and *Acacia xanthophloea*; White 1983 p. 126). Several of these species are also characteristic of biotic *Acacia* wooded grassland [We; especially *Acacia gerrardii* and *Acacia hockii*], Somalia-Masai edaphic grassland [we; especially *Acacia drepanolobium* and *Acacia xanthophloea*], riparian communities (wr; especially *Acacia xanthophloea*) or Undifferentiated woodland (Wn; especially *Acacia polyacantha* and *Acacia sieberiana*; within the greater Serengeti region these species occur as riparian species). Rather than attempting to subdivide these wooded grasslands, we classified all woody grasslands within the Somalia-Masai region and Tanzania as “*Acacia-Commiphora* deciduous wooded grassland (Wd)” except

where vegetation modelling suggested that evergreen bushland (Be) could occur (we mapped these specific areas as biotic *Acacia* wooded grassland [We]; see Volume 6). **We thus think that it is probable that the areas of biotic *Acacia* wooded grassland (We) and Somalia-Masai edaphic grassland (we) are underestimated in Tanzania.** It is also likely that vegetation types similar to Undifferentiated Woodland (Wn) and that can possibly be classified as *Combretum* wooded grassland (Wc) cross the floristic boundary between the Zambezian and Somalia-Masai regions; this seems especially a possible scenario in the southern part of the area that we mapped as *Acacia-Commiphora* deciduous wooded grassland (Wd).

Figure 19.1. *Acacia tortilis* woodland in Isiolo District (Kenya) was classified in VECEA as subtype WdK. Since this vegetation type does not occur near (seasonal) rivers, it was not classified as riverine vegetation. Photograph by F. Gachathi (2008).



## 19.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "I" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 19. Species composition for *Acacia-Commiphora* deciduous wooded grassland (synonym: deciduous wooded grassland, Wd)

SPECIES	Regional status	Tanzania	WdK (Kenya subtype)
<i>Acacia mellifera</i>	indicator species	f	C
<i>Acacia nilotica</i>	indicator species	C	C
<i>Acacia reficiens</i>	indicator species		C
<i>Acacia tortilis</i>	indicator species	C	C
<i>Commiphora schimperi</i>	indicator species	C	f
<i>Cordia monoica</i>	indicator species	x	f
<i>Grewia arborea</i>	indicator species	x	f
<i>Salvadora persica</i>	indicator species	f	C
<i>Acacia drepanolobium</i>		C	f
<i>Acacia gerrardii</i>		C	f
<i>Acacia hockii</i>		C	f
<i>Acacia oerfota</i>		f	C
<i>Acacia polyacantha</i>	riparian species in the Serengeti ecosystem	C	f
<i>Acacia senegal</i>		C	C
<i>Acacia seyal</i>		C	f
<i>Acacia sieberiana</i>	riparian species in the Serengeti ecosystem	C	f
<i>Acacia xanthophloea</i>	riparian species in the Serengeti ecosystem	C	f
<i>Albizia amara</i>	not characteristic	f	C
<i>Balanites aegyptiaca</i>		f	C
<i>Croton dichogamus</i>	not characteristic	f	C
<i>Terminalia brownii</i>		f	C

## 20. Biotic *Acacia* wooded grassland (We)

### 20.1. Description

Where domestic animals<sup>(8)</sup> are numerous, East African evergreen bushland (Be, see Volume 4) has been severely degraded and invaded by *Acacia* species. It is therefore typical to find *Acacia drepanolobium* (a species that also occurs in Somalia-Masai edaphic grassland [we]), *Acacia hockii*, *Acacia kirkii* and *Acacia seyal* (a species that also occurs in Somalia-Masai edaphic grassland [we])) occurring together with evergreen species such as *Carissa edulis*, *Dodonaea viscosa*, *Euclea divinorum*, *Euclea racemosa* and *Tarchonanthus camphoratus* (White 1983 p. 115). In the greater Serengeti region, *Acacia gerrardii* dominates secondary wooded grassland that replaces evergreen bushland, but it also occupies large areas of poorly drained clay soils (White 1983 p. 128).

Evergreen bushland (Be) communities of the Lake Victoria region have been extensively destroyed and replaced by a lightly wooded *Acacia* grassland dominated by *Acacia hockii*, *Acacia gerrardii*, *Acacia kirkii*, *Acacia senegal* (the latter also a characteristic species of deciduous bushland [Bd]<sup>(9)</sup>) and *Euphorbia candelabrum* (also an emergent of evergreen bushland [Be]). White (1983 p. 182) cites references from Lebrun (1947, 1955) and Liben (1961) that suggest the pathways how evergreen thicket can regenerate within biotic *Acacia* wooded grassland. In one pathway, liana species germinate in the shade of the *Acacias*. These lianas eventually smother the crowns of the *Acacias*, which then creates suitable conditions for the establishment of shrubs and bushes. The shade from these shrubs and bushes finally completely suppresses the heliophilous ('sun-loving') *Acacias* that are no longer able to regenerate. In the alternative pathway, the shade from *Euphorbia candelabrum* causes a diminution in the vigour of the grass layer which then allows the invasion of woody plants (White 1983 p. 182).

We suggest that biotic *Acacia* wooded grassland is an **alternative steady state** of potential natural vegetation (corresponding to disturbance by animals) to the steady state of evergreen bushland (Be, corresponding to limited disturbance by animals). The degree of grazing pressure therefore determines the proportions of biotic *Acacia* wooded grassland compared to evergreen bushland (Be).

8: The same situation arises with wild animals

9: The variety of *Acacia senegal* var. *senegal* is a typical variety of biotic *Acacia* wooded grassland, whereas the variety of *Acacia senegal* var. *kerensis* is a typical variety of deciduous bushland (Bd; F. Gachathi, pers. comm.).





Figure 20.1. Vegetation that was originally classified as “*Acacia* wooded grassland of the Rift Valley” (ACB-RV) was reclassified by VECEA as biotic *Acacia* wooded grassland. Early dry season aspect with discontinuous ground cover. Awash National Park near the Fantale volcano (Ethiopia). Photograph by I. Friis and Sebsebe Demissew (October 2006). Reproduced from *Biologiske Skrifter* of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 16A. 2010.



Figure 20.2. *Acacia senegal* var. *senegal* in Kajiado District (Kenya). The variety of *Acacia senegal* var. *senegal* is a typical variety of biotic *Acacia* wooded grassland, whereas the variety of *Acacia senegal* var. *kerensis* is a typical variety of deciduous bushland (Bd). Photograph by F. Gachathi (2008).

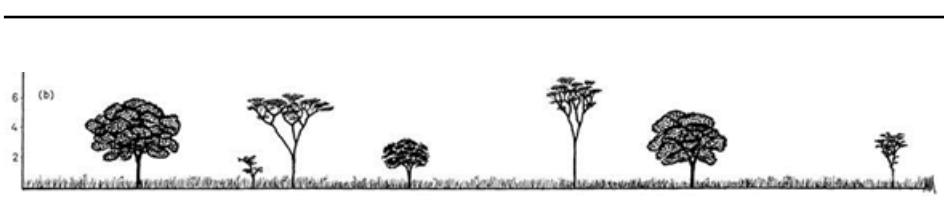


Figure 20.3. *Acacia gerrardii* – *Acacia seyal* wooded grassland with Themeda grass understorey. Height of vegetation in meter. Pratt *et al.* (1966, Fig 3b). Image obtained from URL: <http://www.jstor.org/stable/2401259>



Figure 20.4. Vegetation that was originally classified as “*Acacia – Cymbopogon / Themeda* dry *Acacia* savanna” (original mapping unit P1; *Cymbopogon* and *Themeda* are grass genera) was re-classified as biotic *Acacia* wooded grassland by VECEA. The picture shows an area close to drier *Combretum* wooded grassland (Wcd) near Maddu (Uganda). Photograph by J. Kalema (November 2010).



Figure 20.5. Biotic *Acacia* wooded grassland in Akagera National Park (Rwanda). Photograph by C.K. Ruffo (October 2009).



## 20.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 20. Species composition for biotic *Acacia* wooded grassland (We)

SPECIES	Regional status	Ethiopia	Kenya	Rwanda	Tanzania	WecU (Uganda subtype)	WesU (Uganda subtype)
<i>Acacia gerrardii</i>	indicator species	f	C	C	f	C	C
<i>Acacia hockii</i>	indicator species	f	C	x	f	x	x
<i>Acacia kirkii</i>	indicator species		C	C	f	f	f
<i>Acacia senegal</i>	indicator species	C	x	C	f	x	f
<i>Acokanthera schimperi</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Capparis tomentosa</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Carissa spinarum</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Cussonia holstii</i>	indicator species for evergreen and semi-evergreen bushland and thicket (transition to forest)	f	f	x	f	f	f
<i>Dodonaea viscosa</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Elaeodendron buchananii</i>	indicator species for evergreen and semi-evergreen bushland and thicket (transition to forest)	f	f	x	f	f	f
<i>Euclea divinorum</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Euclea racemosa</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	f	x	f	f	f
<i>Euphorbia candelabrum</i>	indicator species	C	x	C	f	x	f
<i>Grewia bicolor</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x		f	f	f
<i>Grewia similis</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Pterolobium stellatum</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	x	f	f	f
<i>Rhus natalensis</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Schrebera alata</i>	indicator species for evergreen and semi-evergreen bushland and thicket (transition to forest)	f	f	x	f	f	f
<i>Scutia myrtina</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	f	f	f	f
<i>Tarenna graveolens</i>	indicator species for evergreen and semi-evergreen bushland and thicket	f	x	x	f	f	f
<i>Acacia drepanolobium</i>	characteristic species	f	C		f	f	x
<i>Acacia seyal</i>	characteristic species	C	C	C	f	f	x
<i>Grewia tembensis</i>	characteristic species for evergreen bushland and deciduous bushland	f	x				
<i>Acacia brevispica</i>		f	C	f	f	f	f
<i>Acacia mellifera</i>	not characteristic	f	C		f	f	f
<i>Acacia polyacantha</i>		f	C	C	f	f	f
<i>Acacia sieberiana</i>		f	x	C	f	x	f
<i>Acacia tortilis</i>	not characteristic	C	C		f	f	f
<i>Acacia xanthophloea</i>			C		f		
<i>Albizia adianthifolia</i>			f	C	f	x	f
<i>Albizia amara</i>	not characteristic	f	C	C	f	f	f
<i>Allophylus rubifolius</i>		f	x	x	f	f	f
<i>Bersama abyssinica</i>		f	x	x	f	f	f
<i>Boscia angustifolia</i>		f	x	x	f	f	f
<i>Boscia salicifolia</i>		f	x		f	f	x
<i>Combretum molle</i>		f	x	x	f	f	x
<i>Commiphora habessinica</i>		f	x	x	f	f	f
<i>Cordia africana</i>		f	x	x	f	f	f
<i>Cussonia arborea</i>		f	x	x	f	f	f
<i>Dichrostachys cinerea</i>		x	x	f	f	f	f
<i>Dombeya buettneri</i>		f		x			
<i>Dombeya rotundifolia</i>		f	x	x		f	f
<i>Entada abyssinica</i>		f	f	C	f	x	f
<i>Erythrina abyssinica</i>		f	x	x	f	f	f
<i>Erythrina burtii</i>			x				f
<i>Faidherbia albida</i>		C	x		f	f	f
<i>Ficus glumosa</i>		f	x	x	f	f	f
<i>Gardenia ternifolia</i>		f	x	x	f	x	f
<i>Lannea fulva</i>			f	x	f	f	f
<i>Lannea humilis</i>	not characteristic	f	f	x	f	f	x
<i>Lannea schimperi</i>		f	x	x	f	f	x
<i>Lannea schweinfurthii</i>		f	x	x	f	f	f
<i>Maytenus senegalensis</i>		x	x	x	f	x	f
<i>Ozoroa insignis</i>		f	x	x	f	f	f
<i>Pappea capensis</i>		f	x	x	f	f	f
<i>Parinari curatellifolia</i>			x	C	f	f	f
<i>Senna didymobotrya</i>		f	x	x	f	f	f
<i>Terminalia brownii</i>		x	x		f	f	f
<i>Vangueria infausta</i>			x	x	f	f	f
<i>Ximenia americana</i>		f	x	x	f	f	f
<i>Ziziphus abyssinica</i>		f	x	f	f	f	x
<i>Ziziphus mucronata</i>		f	x	x	f	f	f

# 21. Miombo woodland (Wm)

## 21.1. Description

Miombo woodland is floristically and physiognomically very different from other types of woodland. It is nearly always dominated by species of *Brachystegia* (we encountered 15 species when compiling national species compositions, see below) either alone or with *Isoberlinia angolensis*, *Julbernardia globiflora* or *Julbernardia paniculata*. The name “muyombo” (plural: “miyombo”) is a Kinyamwezi name that refers to the tree *Brachystegia boehmii* (Lind and Morrison p. 81; one of our co-authors is a botanist and a Mnyamwezi who confirms the local name of this species). Because the dominant species are extremely gregarious, few other species enter the canopy (except in the more stunted variants). The appearance of miombo is distinctive because of the shape of the dominant trees with boles that are mostly short and relatively slender, with branches that are at first markedly ascending before spreading out to support a light, shallow and flat-topped crown and with leaves that are pinnate. Miombo woodland is mostly 10 to 20 m high, but scrub woodland can as short as 3 m. Most miombo woodlands are semi-deciduous, but some are completely deciduous and some are almost evergreen (White 1983 pp. 92 - 93). There is a marked flush of new leaves (of flaming reds, salmons, pinks and coppery tinges of all hues) just before the rains, a time during which miombo woodlands become especially beautiful (Burt *et al.* 1942; Lind and Morrison 1974 p. 83).

Miombo woodland is the prevalent vegetation throughout the greater part of the Zambezian region, especially on the main plateau and its flanking escarpments where the soils are freely drained but the rooting environment is restricted. Miombo soils often have a restricted rooting environment<sup>(10)</sup> since they are shallow and stony, or since a laterite or gley horizon<sup>(11)</sup> occurs near the surface. On moister and deeper soils in higher rainfall areas, miombo has probably replaced Zambezian dry evergreen forest (Fm)<sup>(12)</sup> or Zambezian transition woodland (an ecotone in between Zambezian dry evergreen forest, see description of Zambezian dry evergreen forest) after cultivation and fire. Areas on certain deep soils where *Brachystegia longifolia*, *B. spiciformis* and *B. utilis* reach a height of 30 m are probably areas where miombo has replaced Zambezian dry evergreen forest<sup>(13)</sup> or Zambezian transition woodland (White 1983 p. 92).

Most of the dominant species of miombo woodland are widely distributed, have wide ecological amplitudes and combine in kaleidoscopic patterns. It is therefore difficult to further subclassify miombo woodland based on distribution of the dominant species (but see below). However, it is possible to make a distinction between wetter miombo and drier miombo based on **associated vegetation types** (White 1983 p. 93):

- Wetter miombo woodland is associated with Zambezian dry evergreen forest and thicket (Fm), Zambezian swamp forest (fs), Zambezian evergreen riparian forest (fr) and wet dambos. Annual rainfall is usually more than 1000 mm, but less on Kalahari Sand.

10: This statement is very often not true as soils under Miombo woodland can be very deep (even up to 8 m; J. Timberlake, personal communication).

11: The statements regarding stony or laterite/gley horizons may be true in plateau regions where miombo is relatively stunted and patchy. It is not the case on escarpment soils which are deep and stone free (P. Smith, pers. comm.). Whereas miombo of the Rift Valley escarpments and steeper hills slopes in Malawi are often on lithosols, this is not always the case. Deeper soils in Kasungu District (Malawi) are covered by typical miombo woodland (C. Dudley, pers. comm.).

12: The interpretation that areas within the Zambezian floristic region that have deeper soils would only have Zambezian dry evergreen forest as the climax vegetation type - and not Miombo woodland - is not generally accepted. It is known that Miombo woodland occurs in areas with deeper soils, and it is not certain that all these areas with deeper soils previously supported Zambezian dry evergreen forest (P. Smith and J. Timberlake, pers. comm.; see also comments for Zambezian dry evergreen forest in Volume 2).

13: Neither Trapnell thought nor I think that miombo has replaced dry evergreen forest. We think (thought) instead that Chipya woodland (Cy in the VECEA map) is part of that succession (P. Smith, personal communication).

Nearly all the dominant species of miombo woodland are included and *Brachystegia floribunda*, *B. glaberrima*, *B. taxifolia*, *B. wangermееana* and *Marquesia macroura* (a principal canopy associate) are widespread.

- Drier miombo woodland is associated with Zambezian dry deciduous forest and thicket (Fn), Zambezian deciduous riparian forest (see fr) and dry dambos. Annual rainfall is less than 1000 mm. *Brachystegia boehmii*, *B. spiciformis* and *Julbernardia globiflora* are often the only dominants that are present, whereas *Brachystegia floribunda* is absent or very local.

**Scrub miombo woodland** occurs at high altitudes, on certain shallow soils and in ecotones between miombo woodland and dambo grassland. Towards the altitudinal limits of miombo (between 1600 and 2100 m), scrub miombo woodland occurs that is no more than 6 m tall and is usually dominated by *Brachystegia spiciformis* and more rarely by *Brachystegia floribunda*, *B. microphylla*, *B. taxifolia* or *Uapaca kirkiana* (a species that occurs scattered in miombo woodland as small trees). Scrub miombo woodland on shallow soils occurs on soils overlying laterite (3 m tall scrub woodland of *Brachystegia boehmii*) and soils derived from siltstone (3 to 5 m tall scrub woodland of *Brachystegia stipulata* and *Julbernardia globiflora*). Most of the dominant species of miombo woodland are usually absent from scrub miombo woodland (usually 4 to 7 m tall) at the edges of dambos, except for *Brachystegia boehmii* (White 1983 p. 99).

Zanzibar-Inhambane transition woodland (communities that are intermediate between forest and woodland where Zanzibar-Inhambane forest species occur together with heliophilous ['sun-loving'] Zambezian woodland species) is dominated by *Brachystegia spiciformis*. Some of these communities are stable, whereas others are clearly seral as forest encroachment can be observed (as some patches in the Shimba Hills where saplings of the forest species *Paramacrolobium coeruleum* [characteristic for moister variants of Zanzibar-Inhambane undifferentiated forest, Fp] form an almost pure understorey). *Brachystegia spiciformis* forms almost pure stands on white sterile sands where complete succession to forest is unlikely, as in the Arabuko-Sokoke forest (Fp; White 1983 p. 188).

The dominant species that were encountered when compiling the species composition for miombo include *Brachystegia allenii*, *Brachystegia boehmii*, *Brachystegia bussei*, *Brachystegia floribunda*, *Brachystegia glaberrima*, *Brachystegia glaucescens*<sup>14</sup>, *Brachystegia longifolia*, *Brachystegia manga*, *Brachystegia microphylla*, *Brachystegia puberula*, *Brachystegia spiciformis*, *Brachystegia stipulata*, *Brachystegia taxifolia*, *Brachystegia utilis*, *Brachystegia wangermееana*, *Isoberlinia angolensis*, *Julbernardia globiflora* and *Julbernardia paniculata*.

Among other *Brachystegia* species listed by White (1983 pp. 92 -93), *Brachystegia bakeriana* and *Brachystegia russelliae* occur in Zambia (based on information from the African Flowering Plants Database), but these are among a limited number of *Brachystegia* species that occur on

14: *Brachystegia glaucescens* is now - incorrectly - treated as a synonym of *Brachystegia microphylla*. However, these species are morphologically and ecologically different (P. Smith and J. Timberlake, personal communication)



Kalahari Sand (the most widespread species is *Brachystegia spiciformis*). *Brachystegia russelliae* is a geoxylic suffrutex (see descriptions of Kalahari woodlands [Wk]), whereas *Brachystegia bakeriana* is sometimes only 1.3 m high due to frost or unfavourable soil conditions (White 1983 pp. 92 and 98). *Brachystegia angustistipulata* and *Brachystegia torrei* are species that are confined to the eastern part of the Zambezian region (i.e. east of the Kalahari Sand) according to White; we have some evidence from the African Flowering Plants Database that *Brachystegia angustistipulata* occurs in Tanzania.



Figure 21.1. Wetter miombo woodland in Zambia (M. Bingham).



Figure 21.2. Wetter miombo woodland in Zambia. Annual grass fires are typical in miombo woodland. Usually not all grass burns each year. (M. Bingham)





Figure 21.3 Miombo woodland (probably near the foothill of Mt. Mulanje as this photograph was obtained from the Mulanje Mountain Conservation Trust; C. Dudley)



Figure 21.4. Some of the typical birds of miombo woodland in their natural habitat. Shell guide to East African birds (1960, reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).

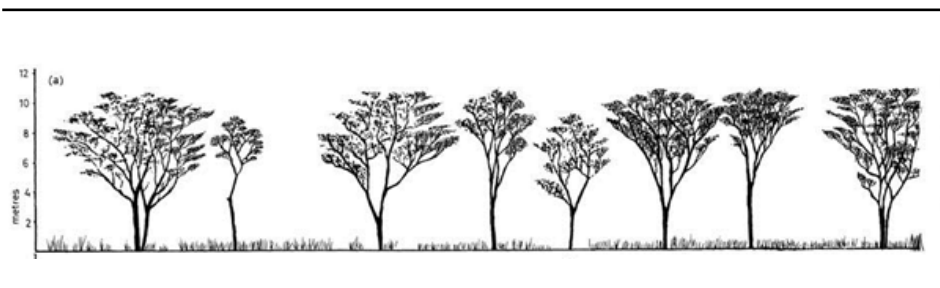


Figure 21.5. Profile diagram of Miombo woodland. Pratt et al. (1966, Fig 3a). Image obtained from URL: <http://www.jstor.org/stable/2401259>



Figure 21.6. *Brachystegia microphylla* upland woodland. *Brachystegia microphylla* is a miombo species that is virtually confined to rocky hills and escarpments (White 1983 p. 93). Gillman (1949, Fig 13). Image obtained from URL: <http://www.jstor.org/stable/211155>



Figure 21.7. Miombo woodland near Morogoro (Tanzania). Photograph by Frank Mbago.



## 21.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "I" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 21. Species composition for Miombo woodland (Wm)

SPECIES	Regional status	Malawi	Tanzania	Zambia	Wmt* (Tanzania subtype)
<i>Acacia polyacantha</i>	indicator species	C	C	C	
<i>Acacia robusta</i>	indicator species (riparian woodland subtype)		f	C	
<i>Acacia sieberiana</i>	indicator species	C	f	C	
<i>Acacia tortilis</i>	indicator species (riparian woodland subtype)	x	f	C	
<i>Albizia amara</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Albizia harveyi</i>	indicator species	C	f	C	
<i>Albizia versicolor</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Borassus aethiopum</i>	indicator species (riparian woodland subtype), palm species	f	C	C	C
<i>Cassia abbreviata</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum adenogonium</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum molle</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Cordyla africana</i>	indicator species (riparian woodland subtype)	C	f	f	
<i>Croton megalobotrys</i>	indicator species (riparian woodland subtype)	f	f	x	
<i>Dalbergia boehmii</i>	indicator species (subtype that occurs on upper valley soils)	f	f	C	
<i>Faidherbia albida</i>	indicator species (riparian woodland subtype)	C	f	C	
<i>Ficus sycamorus</i>	indicator species	f	f	C	
<i>Hyphaene petersiana</i>	indicator species (riparian woodland subtype), palm species	C	f	C	
<i>Kigelia africana</i>	indicator species	f	f	C	C
<i>Lannea schweinfurthii</i>	indicator species (riparian woodland subtype)	x	f	C	
<i>Lonchocarpus capassa</i>	indicator species	C	C	C	C
<i>Markhamia obtusifolia</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Peltophorum africanum</i>	indicator species (subtype that occurs on upper valley soils)	f		C	
<i>Piliostigma thonningii</i>	indicator species (subtype that occurs on upper valley soils)	C	C	x	C
<i>Pterocarpus rotundifolius</i>	indicator species (subtype that occurs on upper valley soils)	x	f	C	
<i>Tamarindus indica</i>	indicator species (riparian woodland subtype)	x	f	C	C
<i>Terminalia mollis</i>	indicator species (subtype that occurs on upper valley soils)		f	C	
<i>Thespesia garckeana</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Trichilia emetica</i>	indicator species	f	f	C	
<i>Xeroderris stuhlmannii</i>	indicator species	C	C	C	
<i>Ziziphus abyssinica</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Acacia erioloba</i>	characteristic species (riparian woodland subtype)			C	
<i>Acacia nigrescens</i>	characteristic species (riparian woodland subtype)	C	f	C	
<i>Adansonia digitata</i>	characteristic species (riparian woodland subtype)	C	f	C	C
<i>Azela quanzensis</i>	characteristic species	C	f	C	
<i>Burkea africana</i>	characteristic species	C	f	C	
<i>Combretum collinum</i>	characteristic species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum imberbe</i>	characteristic species (riparian woodland subtype)	C	f	C	
<i>Pericopsis angolensis</i>	characteristic species (subtype that occurs on upper valley soils)	x	C	C	
<i>Pseudolachnostylis maprouneifolia</i>	characteristic species	C	C	x	
<i>Pterocarpus angolensis</i>	characteristic species	C	f	C	C
<i>Sclerocarya birrea</i>	characteristic species (riparian woodland subtype)	C	C	C	
<i>Terminalia sericea</i>	characteristic species	C	C	C	
<i>Acacia gerrardii</i>		f	f	C	
<i>Acacia mellifera</i>			f	x	
<i>Acacia nilotica</i>		x	f	x	
<i>Acacia seyal</i>		x	f	x	
<i>Acacia xanthophloea</i>					C
<i>Albizia anthelmintica</i>		x	f	x	
<i>Amblygonocarpus andongensis</i>	not characteristic	f	f	C	
<i>Annona senegalensis</i>			C		
<i>Antidesma venosum</i>		x	f	x	
<i>Bauhinia petersiana</i>		x	f	x	
<i>Boscia salicifolia</i>		x	f	x	
<i>Brachystegia bussei</i>	not characteristic	C			
<i>Brachystegia longifolia</i>	not characteristic	f	C	f	
<i>Capparis tomentosa</i>		f	f	x	
<i>Clerodendrum myricoides</i>			f	x	C
<i>Combretum zeyheri</i>	(Combretaceae)	C	f	x	
<i>Commiphora africana</i>		x	f	f	
<i>Commiphora habessinica</i>			f	x	
<i>Crossopteryx febrifuga</i>		x	f		
<i>Dalbergia melanoxylon</i>		x	f	x	
<i>Dalbergia nitidula</i>		x	f	f	
<i>Dichrostachys cinerea</i>		x	f	x	
<i>Diospyros kirkii</i>		x	f	x	
<i>Diplorhynchus condylocarpon</i>	not characteristic	x		x	
<i>Entada abyssinica</i>		f	f	x	
<i>Erythrina abyssinica</i>		f	f	C	C
<i>Erythrophleum africanum</i>	not characteristic	x	C	C	
<i>Euclea divinorum</i>		x	f	f	
<i>Faurea rochetiana</i>			f	x	
<i>Flacourtia indica</i>		x	f	f	
<i>Flueggea virosa</i>		x	f	x	
<i>Gardenia ternifolia</i>		x	f		
<i>Grewia bicolor</i>		x	f	x	
<i>Harungana madagascariensis</i>		f	f	x	

SPECIES	Regional status	Malawi	Tanzania	Zambia	WmrZ (Zambia subtype)	Wms (scrub miombo subtype)	Coast
<i>Ozoroa insignis</i>	not characteristic	x	f	f			f
<i>Piliostigma thonningii</i>	not characteristic	x	f	f			f
<i>Sclerocarya birrea</i>	not characteristic						x
<i>Securidaca longipedunculata</i>		x	f	x			f
<i>Smilax anceps</i>	not characteristic		f	x			
<i>Strychnos cocculoides</i>		x	f	x			f
<i>Strychnos innocua</i>		x	f	x			f
<i>Syzygium guineense</i>	not characteristic	f	f	C	x		f
<i>Thespesia garckeana</i>	not characteristic	x	f	f			
<i>Uapaca kirkiana</i>	species that occurs scattered in miombo as small trees; sometimes in scrub woodland near altitudinal limits of miombo woodland	x	f	x		x	
<i>Uapaca nitida</i>		x	f	x			f
<i>Vangueriopsis lanciflora</i>	not characteristic	x	f	f		x	
<i>Vitex mombassae</i>		x	f	x			f
<i>Xeroderris stuhlmannii</i>	not characteristic	x	f	f			f
<i>Ziziphus abyssinica</i>	not characteristic	x	f	f			f
<i>Ziziphus mucronata</i>	not characteristic	x	f	f			f

## 22. North Zambezian undifferentiated woodland and wooded grassland (synonym: undifferentiated woodland, Wn)

### 22.1. Description

The name of “North Zambezian undifferentiated woodland and wooded grassland” directly corresponds to the name given by White for this vegetation type (White 1983 p. 95). **Given that this name is quite long, we use the abbreviation of “Undifferentiated woodland (Wn)” throughout this and other VECEA volumes. A synonym for this vegetation type is "Munga woodland".**<sup>(15)</sup>

Undifferentiated woodland can be more easily defined by the absence of the dominant species of miombo woodland (Wm) and mopane woodland and scrub woodland (Wo) than by its own floristic composition. Although the dominants of miombo woodland are usually absent, some of the associated species are frequently present such as *Azelia quanzensis*, *Burkea africana*, *Dombeya rotundifolia*, *Pericopsis angolensis*, *Pseudolachnostylis maprouneifolia*, *Pterocarpus angolensis* or *Terminalia sericea*. Despite its small area, it is composed of many more tree species than either miombo or mopane (White 1983 p. 95).

Frank White reserved the term of “undifferentiated forests” to forests that undergo rapid and kaleidoscopic changes in structure and species composition over short distances (White 1983 p. 47). We expect that a similar definition applies to “undifferentiated woodlands” and “undifferentiated wooded grasslands” since White (1983 p. 95) describes that “there is considerable floristic overlap between different examples and variation is more or less continuous”.<sup>(16)</sup> We have evidence that the vegetation type of “undifferentiated woodland” of The Vegetation Map of Africa (White 1983) corresponds - at least partially - to *Combretum* wooded grassland types of some national references (see Box 1).

Undifferentiated woodland occurs towards or slightly beyond the drier climatic limits of miombo woodland (Wm) on certain soils that are unsuitable for mopane woodland and wooded grassland (Wo) – for example freely drained granite soils. The most extensive occurrences appear to be largely secondary, however (White 1983 p. 95).

White describes two main variants of Undifferentiated woodland (Wn): (i) riparian woodland and wooded grassland; and (ii) Undifferentiated woodland on upper valley soils in Zambia (White 1983 p. 95).

- Riparian woodland and wooded grassland is extensively developed on alluvium fringing the larger permanent watercourses in the drier half of the Zambezian region. Most riparian woodland is probably degraded riparian forest (fr) or riparian transition woodland since it is a favourite habitat of elephants. Riparian woodland can also be

15: One of the direct references that White (1983 p. 95) provides for the North Zambezian Undifferentiated woodland are pages 50 to 55 of Fanshawe (1971) - these are the pages where Fanshawe describes and gives the species composition of “Munga woodland”. Fanshawe (1971 p. 51) says that the term “Munga” was coined by Frank White (1965) as a term that was preferable to “savanna”. The White (1965 p. 667) manuscript describes that “Within the enormous areas occupied by miombo woodland, there exist patches of various extent from which miombo is excluded because of soil differences. The soils are usually heavier and more fertile than miombo soils and are often deeper (...) They often occur on alluvium (...) Present day vegetation characteristically consists of tall, dense grassland with a varying density of fire-resistant trees. These trees comprise the “Munga” element. “Munga” is as Tonga word for “thorn tree” which is applied to several species of *Acacia*, including *Acacia sieberiana*, *Acacia albida* (now: *Faidherbia albida*) and *Acacia polyacantha* which are frequent and characteristic components of this vegetation type.”

16: One example of “kaleidoscopic changes” (referring to changes in species composition over space rather than over time) within Undifferentiated woodland was described for Lengwe National Park (Malawi) by Hall-Martin. Whereas various vegetation subtypes can be clearly distinguished on the ground and be included on maps at smaller scales (1:50,000 to 1:25,000), at larger scales (as used in the base maps used by the VECEA project) these types can only be mapped as mosaics. As one walks through Undifferentiated woodland, one passes through variable sized areas of different species complexes that each can be characterized floristically, structurally and edaphically. Whether these patches are “real” or mainly related to random processes of seed dispersal, germination and survival is not certain, but sharp boundaries can be observed between these patches (C. Dudley, pers. comm.).



an edaphic climax - this is especially the case for seasonally flooded heavy clay soils.

- Upper valley soils in Zambia are formed at lower altitudes than the surrounding plateaux, have greater fertility than soils of the plateau and favour intensively rooting species since they provide a good rooting environment. The original vegetation was probably thicket with numerous emergent trees, dry forest (Fm or Fn) or transition woodland. These original communities have been replaced by secondary woodlands and wooded grasslands.

Species that were listed both for riparian and upper valley sites include *Acacia polyacantha*, *Acacia sieberiana*, *Azelia quanzensis*, *Albizia harveyi*, *Burkea africana*, *Ficus sycomorus*, *Kigelia africana*, *Lonchocarpus capassa* (current name: *Philenoptera violacea*), *Pseudolachnostylis maprouneifolia*, *Pterocarpus angolensis*, *Terminalia sericea*, *Trichilia emetica* and *Xeroderris stuhlmannii* (White 1983 p. 95).

Undifferentiated woodland (Wn) corresponds to mapping unit 29c of the vegetation map of Africa (White 1983). White (1983) distinguishes a separate mapping unit 35a which he named “Transition from undifferentiated woodland to *Acacia* deciduous bushland and wooded grassland”. The only description that White (1983 p. 62) gave for this vegetation type in the Zambezian region is of a woodland and wooded grassland that is dominated by *Acacia* and broad-leaved trees that is greatly modified by fire and extensively developed on the alluvium in the Rukwa valley (Tanzania).

However, White (1983) refers to an article by Pielou (1952). Pielou (1952) provides a description and two profile diagrams (see Figure 9.5) that depict an “escarpment” zone and a “fringing bush” zone. (The latter occurs on a flat area in between the escarpment and the “alkaline plain” of Lake Rukwa, and was described as wooded grassland by Pielou [1952]). Unfortunately, various species were not identified, including *Acacia* and *Combretum* species. In the VECEA map, we reclassified the physiognomic class of “bushland and thicket” that occurred in the vicinity of Lake Rukwa as “Transition from undifferentiated woodland to *Acacia* deciduous bushland and wooded grassland” (see Volume 6). We expect that the area mapped in the VECEA map therefore mainly depicts the “fringing bush” zone.”

**Box 1.** The correspondence between the “undifferentiated woodlands” of the Vegetation Map of Africa (White 1983) and *Combretum* wooded grassland types

Within the VECEA map, we have not mapped *Combretum* wooded grassland (mapping unit Wc) within the Zambezian region. We made this decision for cartographic and floristic reasons. However, we have various lines of evidence that within the Zambezian region, *Combretum* wooded grasslands are equivalent - at least partially - to Undifferentiated woodland (especially where Undifferentiated woodland occurs in catena sequences in between Miombo woodland [Wm] and edaphic grassland ["dambos", g]).:

- Fanshawe (1971) describing Undifferentiated woodland mentions that both lower valley and upper valley types of Munga woodland can be further subdivided in (i) *Combretum-Terminalia* variants on the more elevated, better drained sites; and (ii) *Acacia* variants on the less elevated, poorer drained sites.
- The soil - vegetation map of Zambia that was prepared by Trapnell *et al.* (1950) distinguishes between *Combretum* - *Pericopsis*, *Acacia* - *Combretum* and *Pterocarpus* - *Combretum* vegetation types, whereas these types all correspond to Undifferentiated woodland (as indicated on the legend of the Edmonds and Fanshawe [1976] map).
- Trapnell and Langdale-Brown (1972, p. 133) describing *Combretum* wooded grassland (Wc), mention that various broad-leaved *Combretum* species are associated with smaller-leaved species of ***Terminalia sericea*** in the “monsoon sector” of Tanzania (*i.e.* areas with a one-season summer rainy season typically occupied by miombo woodland [Wm]). They further mention that in the “monsoon sector”, the characteristic combination is *Combretum* with Papilionaceae, notably *Pericopsis angolensis* and ***Xeroderris stuhlmannii*** (synonym: *Ostryoderris stuhlmannii*) The corresponding vegetation map of East Africa includes the topographic sequence of 3c / 4, indicating higher lying *Brachystegia* and other species woodlands of Tanganyika (‘miombo’) in a topographic sequence with lower lying wooded grassland (see volume 6).
- White (1983 p. 95) includes various *Combretum* species (*Combretum adenogonium*, *C. collinum*, *C. imberbe* and *C. molle*) and one *Terminalia* species (*Terminalia mollis*) in Undifferentiated woodland.
- Central African Rail Link Development Survey (1952) vegetation maps (8 and 12) for Tanzania includes woodland of Combretaceae ± Papilionaceae (map symbol J). The maps clearly depict the pattern that *Combretum* woodland occurs in a catenary sequence between miombo woodland and edaphic “valley grasslands” (see Figure 9.1). Moreover, the documentation of the map (CARLDS

1952 p. 64) mentions that “mixed types of Combretaceae woodland with *Brachystegia* - *Isoberlinia* woodland [*i.e.* miombo woodland]) (...) occur on broken topography where *Brachystegia*-*Isoberlinia* vegetation on hill tops and upper slopes alternates with Combretaceae woodland on colluvial soils on lower slopes and valley bottoms (CARLDS 1952, page 64).

- Gillman (1949, p. 28) describes the central plateau catena<sup>17</sup> mapping unit from the vegetation map of Tanzania (that he made) carrying the typical vegetation sequence of *Brachystegia* and other species woodland (miombo) on the comparatively well drained ridges and their upper and middle slopes, grassland in the valley bottoms, and *Combretum* and other species wooded grassland or bushland in varying widths between the miombo woodland and grassland. (This description corresponds well with the *Combretum* - *Acacia* - *Piliostigma* woodland and thicket subtype of Malawi's central plateau; C. Dudley, pers. comm.)
- Lind and Morrison (1974 p. 81) describe that Miombo woodlands occupy two great blocks (a central plateau in the north and a south-eastern plateau) that are remnants of Miocene and Tertiary peneplains. On these moderately undulating peneplain, broad, flat and gently sloping ridges alternate with shallow, low-grade, flat-bottomed and seasonally inundated valleys that are known as ‘mbugas’. The well-drained ridges bear miombo on their upper and middle slopes, the valley bottoms bear grassland and the narrow marginal region in between bears bushland or wooded grassland with *Combretum* and other species. Lind and Morrison (1974 p. 90) further mention that in Tanzania, Combretaceous wooded grasslands are not so widespread and are mainly found in the catena of the miombo woodlands.
- Burt et al. (1942 p. 111) describe *Combretum zeyheri* - ***Terminalia sericea*** - ***Xeroderris*** woodlands that occur in the Lake Province of Tanzania (around Shinyanga) between *Brachystegia spiciformis* woodland and hard-pan alluvium below.

17: Gillman (1949 p. 25) defines a catena (or “catenary complex”) as “a distributional sequence of vegetation types determined by a given set of regularly repeated physiographic or hydrographic conditions (including their effect on soils), the arrangement of vegetation types being a function of local differences in topography that are constantly repeated over the catenary area.” He also mentions that “the catena (...) is merely a device to permit a more correct representation of the vegetational facts on a small-scale map than the usual misrepresentation that results from showing only a single dominant type.”

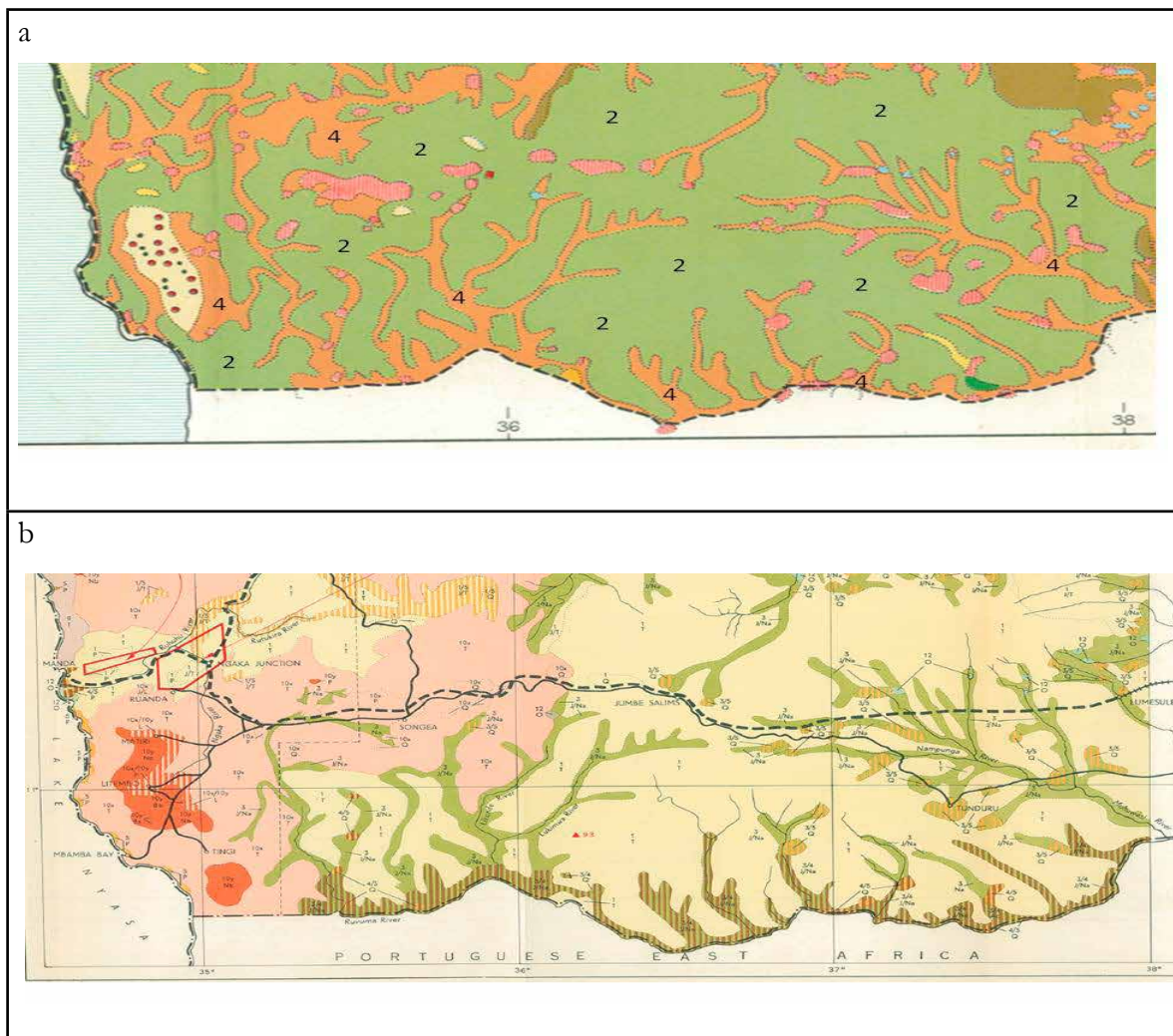


Figure 22.1 Most areas that were mapped as wooded grassland in the south-west of the Gillman (1949) physiognomic map correspond with areas that are mapped as *Combretaceae ± Papilionaceae* woodland in the Central African Rail Link Development Survey (CARLDS 1952) maps.

a: south-west of the Gillman (1949) map; 2: woodland (coding added afterwards); 4: wooded grassland (coding added afterwards). b: CARLDS (1952) Map 8; T: *Brachystegia-Isobерlinia* woodland; J: Woodland of *Combretaceae ± Papilionaceae*; Na: valley grassland. (In the CARLDS maps, different colours correspond to different soil types). These figures show the same patterns that can be observed in the Kasungu landscape of Malawi; C. Dudley, pers. comm.)

Figure 22.2 *Acacia polyacantha* on the Kafue flats in Zambia. *Acacia polyacantha* is a typical species of North Zambezian undifferentiated woodland ("Undifferentiated woodland" in the VECEA map), occurring both in riparian and upper valley subtypes (White 1983 p. 95). Photograph by M. Bingham.



Figure 22.3 Undifferentiated woodland near Morogoro in Tanzania. *Brachystegia* species (dominant in miombo woodland) are absent in this vegetation type (F. Mbago).







Figure 22.4. Undifferentiated woodland near Morogoro in Tanzania. This vegetation type was originally described as "*Combretum savannah*", but was reclassified in the VECEA map as Undifferentiated woodland (Wn). The species in the centre is the co-dominant *Acacia nigrescens*. Burtt et al. (1942, Fig. 48). Image obtained from URL: <http://www.jstor.org/stable/2256690>.

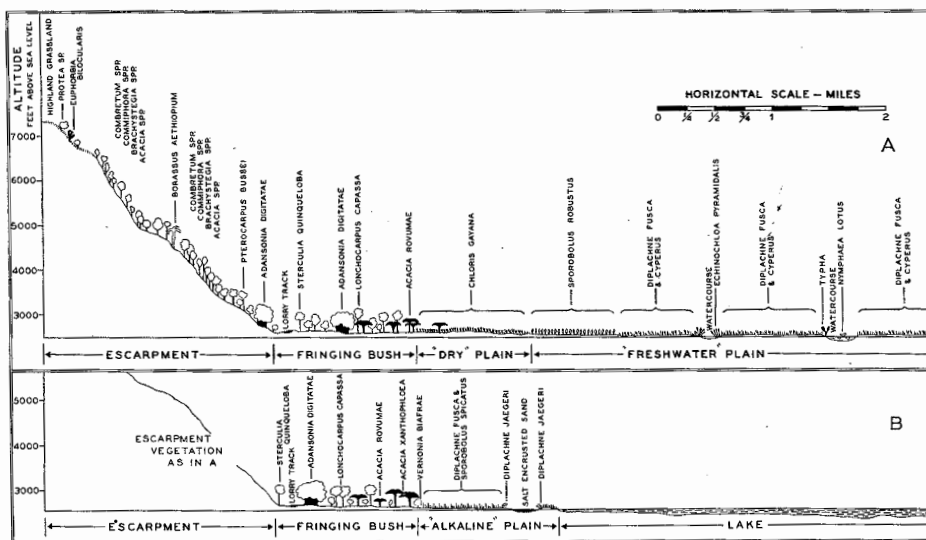


Figure 22.5. Transition from undifferentiated woodland to *Acacia* deciduous bushland and wooded grassland (mapping unit 35a in White 1983) next to Lake Rukwa (Tanzania). White (1983) does not describe mapping unit 35a in his treatment of the Zambezian floristic region, whereas White (1983, p. 62) directly refers to Pielou (1952, Fig. 2). Image obtained from URL: <http://www.jstor.org/stable/2256807>.

## 22.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 22. North Zambeian undifferentiated woodland and wooded grassland (synonym: undifferentiated woodland, Wn)

SPECIES	Regional status	Malawi	Tanzania	Zambia	Wnt (Tanzania subtype)
<i>Acacia polyacantha</i>	indicator species	C	C	C	
<i>Acacia robusta</i>	indicator species (riparian woodland subtype)		f	C	
<i>Acacia sieberiana</i>	indicator species	C	f	C	
<i>Acacia tortilis</i>	indicator species (riparian woodland subtype)	x	f	C	
<i>Albizia amara</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Albizia harveyi</i>	indicator species	C	f	C	
<i>Albizia versicolor</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Borassus aethiopum</i>	indicator species (riparian woodland subtype), palm species	f	C	C	C
<i>Cassia abbreviata</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum adenogonium</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum molle</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Cordyla africana</i>	indicator species (riparian woodland subtype)	C	f	f	
<i>Croton megalobotrys</i>	indicator species (riparian woodland subtype)	f	f	x	
<i>Dalbergia boehmii</i>	indicator species (subtype that occurs on upper valley soils)	f	f	C	
<i>Faidherbia albida</i>	indicator species (riparian woodland subtype)	C	f	C	
<i>Ficus sycomorus</i>	indicator species	f	f	C	
<i>Hyphaene petersiana</i>	indicator species (riparian woodland subtype), palm species	C	f	C	
<i>Kigelia africana</i>	indicator species	f	f	C	C
<i>Lannea schweinfurthii</i>	indicator species (riparian woodland subtype)	x	f	C	
<i>Lonchocarpus capassa</i>	indicator species	C	C	C	C
<i>Markhamia obtusifolia</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Peltophorum africanum</i>	indicator species (subtype that occurs on upper valley soils)	f		C	
<i>Piliostigma thonningii</i>	indicator species (subtype that occurs on upper valley soils)	C	C	x	C
<i>Pterocarpus rotundifolius</i>	indicator species (subtype that occurs on upper valley soils)	x	f	C	
<i>Tamarindus indica</i>	indicator species (riparian woodland subtype)	x	f	C	C
<i>Terminalia mollis</i>	indicator species (subtype that occurs on upper valley soils)		f	C	
<i>Thespesia garckeana</i>	indicator species (subtype that occurs on upper valley soils)	x	f	x	
<i>Trichilia emetica</i>	indicator species	f	f	C	
<i>Xeroderris stuhlmannii</i>	indicator species	C	C	C	
<i>Ziziphus abyssinica</i>	indicator species (subtype that occurs on upper valley soils)	C	f	C	
<i>Acacia erioloba</i>	characteristic species (riparian woodland subtype)			C	
<i>Acacia nigrescens</i>	characteristic species (riparian woodland subtype)	C	f	C	
<i>Adansonia digitata</i>	characteristic species (riparian woodland subtype)	C	f	C	C
<i>Azvelia quanzensis</i>	characteristic species	C	f	C	
<i>Burkea africana</i>	characteristic species	C	f	C	
<i>Combretum collinum</i>	characteristic species (subtype that occurs on upper valley soils)	x	f	x	
<i>Combretum imberbe</i>	characteristic species (riparian woodland subtype)	C	f	C	
<i>Pericopsis angolensis</i>	characteristic species (subtype that occurs on upper valley soils)	x	C	C	
<i>Pseudolachnostylis maprouneifolia</i>	characteristic species	C	C	x	
<i>Pterocarpus angolensis</i>	characteristic species	C	f	C	C
<i>Sclerocarya birrea</i>	characteristic species (riparian woodland subtype)	C	C	C	
<i>Terminalia sericea</i>	characteristic species	C	C	C	
<i>Acacia gerrardii</i>		f	f	C	
<i>Acacia mellifera</i>		f	x		
<i>Acacia nilotica</i>		x	f	x	
<i>Acacia seyal</i>		x	f	x	
<i>Acacia xanthophloea</i>					C
<i>Albizia anthelmintica</i>		x	f	x	
<i>Amblygonocarpus andongensis</i>	not characteristic	f	f	C	
<i>Annona senegalensis</i>			C		
<i>Antidesma venosum</i>		x	f	x	
<i>Bauhinia petersiana</i>		x	f	x	
<i>Boscia salicifolia</i>		x	f	x	
<i>Brachystegia bussei</i>	not characteristic	C			
<i>Brachystegia longifolia</i>	not characteristic	f	C	f	
<i>Caparis tomentosa</i>		f	f	x	
<i>Clerodendrum myricoides</i>			f	x	C
<i>Combretum zeyheri</i>	(Combretaceae)	C	f	x	
<i>Commiphora africana</i>		x	f	f	
<i>Commiphora habessinica</i>			f	x	
<i>Crossopteryx febrifuga</i>		x	f		
<i>Dalbergia melanoxylon</i>		x	f	x	
<i>Dalbergia nitidula</i>		x	f	f	
<i>Dichrostachys cinerea</i>		x	f	x	
<i>Diospyros kirkii</i>		x	f	x	
<i>Diplorhynchus condylocarpon</i>	not characteristic	x		x	
<i>Entada abyssinica</i>		f	f	x	
<i>Erythrina abyssinica</i>		f	f	C	C
<i>Erythrophloeum africanum</i>	not characteristic	x	C	C	
<i>Euclea divinorum</i>		x	f	f	
<i>Faurea rochetiana</i>			f	x	
<i>Flacourtia indica</i>		x	f	f	
<i>Flueggea virosa</i>		x	f	x	
<i>Gardenia ternifolia</i>		x	f		
<i>Grewia bicolor</i>		x	f	x	
<i>Harungana madagascariensis</i>		f	f	x	

SPECIES	Regional status	Malawi	Tanzania	Zambia	WntT (Tanzania subtype)
<i>Kirkia acuminata</i>	not characteristic	C	f	C	
<i>Lannea discolor</i>	not characteristic	x		x	
<i>Maytenus senegalensis</i>		f	f	x	
<i>Oxytenanthera abyssinica</i>	(bamboo species indigenous to Africa)	x	f	x	
<i>Ozoroa insignis</i>	not characteristic	C	f	x	
<i>Parinari curatellifolia</i>	not characteristic	x	f	C	
<i>Phoenix reclinata</i>	(palm species)	f	f	x	
<i>Pterocarpus lucens</i>		f		C	
<i>Salvadora persica</i>		x	f	x	
<i>Schinziophyton rautanenii</i>	not characteristic		f	C	
<i>Securidaca longipedunculata</i>		x	f	x	
<i>Sesbania sesban</i>		f	f	x	
<i>Sterculia africana</i>		C	f	f	
<i>Sterculia quinqueloba</i>		C	f	f	C
<i>Stereospermum kunthianum</i>		x	C	f	
<i>Strychnos cocculoides</i>		f	f	x	
<i>Strychnos potatorum</i>		C		C	
<i>Strychnos spinosa</i>		x	f	x	
<i>Syzygium guineense</i>	not characteristic	f	f	x	
<i>Terminalia prunioides</i>	(Combretaceae)		f	x	
<i>Trema orientalis</i>		f	f	C	
<i>Uapaca kirkiana</i>					C
<i>Vernonia amygdalina</i>		f	f	x	
<i>Ximenia americana</i>		x	f	x	
<i>Ziziphus mauritiana</i>		f	f	C	

## 23. Palm wooded grassland physiognomically easily recognized type, P)

### 23.1. Description

White (1983) did not describe palm wooded grasslands as a separate vegetation type in his main treatment of floristic regions. However, he describes *Hyphaene coriacea* palm stands that occur on sites with permanent ground water at the edge of the Chalbi desert and at the base of Mt. Kulal (White 1983 p. 123). *Borassus aethiopum* and *Hyphaene petersiana* (synonym: *Hyphaene ventricosa*) are among the characteristic species of the riparian woodland subtype of Undifferentiated woodland and wooded grassland (Wn, White 1983 p. 95). *Borassus aethiopum* is listed to occur in seasonally inundated flood plains in the Sudanian floristic region (White 1983 p. 107). *Borassus aethiopum* and *Hyphaene thebaica* occur on transition zones between swamp grassland and better drained areas with *Acacia seyal* in the flood region of the Nile (White 1983 p. 108). *Hyphaene compressa* occurs in Zanzibar-Inhambane edaphic wooded grassland (White 1983 p. 189). *Phoenix reclinata* and *Raphia farifera* are palm species that are listed among the more important species of swamp forests that are widespread in the Lake Victoria region and elsewhere (White 1983 p. 181). *Phoenix reclinata* occurs in swamp forests in the Zanzibar-Inhambane region (White 1983 p. 188).

Lind and Morrison (1974 p. 94) mention that palm wooded grassland is limited in area, but so noticeable that it needed to be included in descriptions of East African vegetation types. The main species is *Borassus aethiopum*. In Uganda, it is found on sands and sandy loams with mobile ground water. In Kenya, it is scattered through the coastal belt and is noticeable on the Shimba Hills. In Tanzania, extensive stands occur in the flood plains of the Igombe and Ugala rivers and other riverine communities where it is sometimes accompanied by *Hyphaene doum* palm species. *Hyphaene coriacea* is the dominant palm species on the Ruaha - Usangu plain complex and in the Warmi and Mkata flood plains. *Borassus* stands are more common than *Hyphaene* in parts of the coastal plain, but small trees (up to 3 m) of *Hyphaene* form extensive stands in grassland on poorly drained sands.

From the descriptions above it is clear that the palm stands that were described often occur in areas with drainage impediments or riverine locations. It would therefore be perfectly acceptable to classify and map these vegetation types as “edaphic wooded grassland” (wd) or “riverine wooded grassland” (wr), which we have done in several situations. We think that discrimination between these types is more a question of the scale of mapping since palm trees can easily be identified in the field.





Figure 23.1. *Borassus - Hyperthelia dissoluta* [a grass species, synonym: *Hyparrhenia dissoluta*,] palm wooded grassland (original mapping unit M2) from Uganda. Photograph by J. Kalema.



Figure 23.2. Stand of *Phoenix reclinata* in waterlogged area within Afromontane rain forest (Fa). Photograph by I. Friis and Sebsebe Demissew. Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 25G. 2010.



Figure 23.3. *Hyphaene petersiana* wooded grassland next to the Shire River marsh and lagoons (Liwonde National Park, Malawi). An alternative classification method for this vegetation type would have been as "edaphic wooded grassland on drainage-impaired or seasonally flooded soils". Photograph by C. Dudley.



## 23.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 23. Species composition for Palm wooded grassland physiognomically easily recognized type, P)

SPECIES	Regional Status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	P1U (Uganda subtype)	P2U (Uganda subtype)	Zambia	Coast
<i>Borassus aethiopum</i>	Palm species (occurs in the riparian woodland subtype of north Zambezan undifferentiated woodland, in Sudanian edaphic grassland on Pleistocene clays, and in Zanzibar-Inhambane secondary grassland and wooded grassland)	C	C	f		f	D	D	f	C
<i>Cocos nucifera</i>	Palm species (occurs in Zanzibar-Inhambane edaphic grassland and secondary grassland)		C			f				C
<i>Elaeis guineensis</i>	Palm species		C	f		f	f	f		C
<i>Hyphaene compressa</i>	Palm species (occurs in Zanzibar-Inhambane edaphic grassland and secondary grassland)	C	C			f				C
<i>Hyphaene coriacea</i>	Palm species (small stands with permanent ground water at the edge of the Chalbi desert and at the base of Mt. Kulal)		C			f				C
<i>Hyphaene petersiana</i>	Palm species (occurs in the riparian woodland subtype of north Zambezan undifferentiated woodland)			D		f			C	
<i>Hyphaene thebaica</i>	Palm species (occurs in Sudanian undifferentiated woodland and in Sudanian edaphic grassland on Pleistocene clays)	C								
<i>Phoenix reclinata</i>	Palm species (small communities in areas with frequent landslides on Mt. Kulal, Lake Victoria swamp forest, Zanzibar-Inhambane swamp forest)	C	C	f	C	f	f	f	f	C
<i>Raphia farinifera</i>	Palm species (occurs in Lake Victoria swamp forest)		C	f		f	f	f	f	C
<i>Acacia erioloba</i>									C	
<i>Acacia nigrescens</i>				C					f	
<i>Acacia polyacantha</i>				f			x	x	f	
<i>Acacia sieberiana</i>				C			x	x	f	
<i>Acacia xanthophloea</i>				C						
<i>Adansonia digitata</i>				C					f	
<i>Albizia versicolor</i>				C			f	f	f	
<i>Burkea africana</i>				f			f	f	C	
<i>Combretum collinum</i>				f			x	x	f	
<i>Diospyros mespiliformis</i>				C			f	f	f	
<i>Faidherbia albida</i>				C			f	f	f	
<i>Kigelia africana</i>				C				x	f	
<i>Lannea schweinfurthii</i>				C			f	f	f	
<i>Lonchocarpus capassa</i>				C					f	
<i>Piliostigma thonningii</i>				C			x	x	f	
<i>Sterculia africana</i>				C					f	
<i>Terminalia sericea</i>				f					C	
<i>Trichilia emetica</i>				C			f	f	f	

## 24. Edaphic wooded grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type, wd)

### 24.1. Description

It is not always easy to discriminate between riverine wooded grasslands and edaphic wooded grasslands (there is a similar problem in differentiating riverine forest from swamp forests, see Volume 2). We were probably not consistent in allocating mapping units from national maps to riverine or edaphic wooded grasslands, but where proximity to a river was obvious, we preferred the classification of riverine wooded grasslands. The edaphic wooded grasslands that we classified as such typically contained *Acacia* species. Wooded grasslands dominated by palm species are sometimes riverine or indicative of conditions of impeded drainage, but we classified these vegetation types separately (VECEA mapping unit “P”, see section 15) since they are easy to be distinguished in the field, from aerial photographs or even some satellite imagery.

White (1983) did not strictly apply a differentiation between edaphic wooded grassland (with cover percentages of 10 - 40% woody species) and edaphic grassland (with cover percentages of <10% woody species) since both types intergrade and edaphic wooded grasslands are often difficult to delimit from the more open grasslands with which they are associated (White 1983 pp. 50 - 52). **Within the VECEA map, we loosely defined “edaphic wooded grassland” as “edaphic grassland with scattered woody species” and “edaphic grassland” as “edaphic grassland without scattered woody species”. This means that some vegetation types that would have been classified as “edaphic grasslands” in a strict physiognomic classification system (i.e. woody cover < 10%) may have been allocated to “edaphic wooded grasslands”.**<sup>(18)</sup>

Although White (1983) described edaphic grasslands and wooded grasslands separately for the various floristic regions, we did not apply a floristic classification system to edaphic grasslands and edaphic wooded grasslands (although we directly relied on the information that was provided by White in descriptions of a particular floristic region).

Edaphic grassland areas of the Zambezian region were mapped and described as grasslands, including suffrutex grassland areas that are considered as wooded grasslands (mapping unit g, see Volume 5) by some authors.

In the Somalia-Masai region, water-receiving depressions covered with black and cracking clays are extensively developed in Central Tanzania; these depressions do not have sufficient run-off to carve stream beds and quickly evaporate in the dry season. The principal grasses that cover these

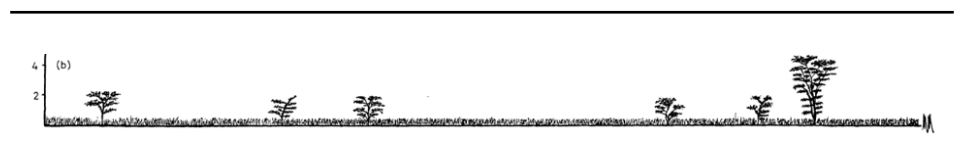
18: The definition of "grasslands" of Pratt *et al.* (1966) of "land dominated by grasses and occasionally other herbs; sometimes with widely scattered or grouped trees and shrubs, the canopy cover of which does not exceed 2%" may therefore provide a more accurate physiognomic definition of vegetation types that were classified as "edaphic grassland" by the VECEA project.

depressions (“mbugas”<sup>(19)</sup>) are *Setaria incrassata* and *Themeda triandra*. The *mbugas* are treeless but are usually separated by an ecotone of wooded grassland that is dominated by various gall *Acacia* species, including *Acacia drepanolobium*, *Acacia malacocephala*, *Acacia pseudofistula* and *Acacia seyal*. Seasonally waterlogged (wooded) grassland also occurs as ill-defined glades on non-cracking calcimorphic “hard pan” soils within deciduous bushland (Bd). The dominant grass species in these glades are dwarf grasses, including *Microchloa indica*. The glades do not have trees or have scattered individuals of *Acacia drepanolobium*, *Acacia mellifera*, *Acacia tanganyikensis*, *Acacia tortilis*, *Albizia amara*, *Albizia harveyi*, *Commiphora schimperi*, *Dalbergia melanoxylon*, *Lannea humilis*, *Sclerocarya birrea* and *Terminalia stuhlmannii*. Ill-defined areas of inland drainage in Somalia are covered with *Cynodon dactylon* and *Chloris roxburghiana* and have scattered *Acacia tortilis* (White 1983 p. 116).

Various types of edaphic wooded grassland are described for the Sudanian floristic region, including those occurring on the Pleistocene clays of the Nile Valley. Within the flood region, areas of slightly higher grounds that are only flooded to a shallow depth and where annual rainfall is in between 570 and 1000 mm are covered with *Acacia seyal*. The transition zones in between swamp grasslands (containing *Setaria incrassata*) and the better drained areas are sometimes dominated by the palm species *Borassus aethiopum* and *Hyphaene thebaica*, either single or together (White 1983 p. 108).

Zanzibar-Inhambane edaphic (wooded) grassland cover large areas of grey-black cracking clay soils near the mouth of the Tana river. These grasslands are studded with thicket-covered termite mounds (described separately as Termitary vegetation [T, see Volume 4]). There are widely spaced individuals of *Acacia zanzibarica*, *Hyphaene compressa*, *Terminalia spinosa* and *Thespesia danis* (White 1983 p. 189).

Figure 24.1. Profile diagram of seasonally waterlogged wooded grassland with *Acacia drepanolobium*. Height of vegetation in meter. The grass species is *Pennisetum mezianum*. Pratt et al. (1966, Fig 5b). Image obtained from URL: <http://www.jstor.org/stable/2401259>.



19: The definition given (White 1983 p. 269) is of “water-receiving depressions in East Africa covered with grassland and *Acacia*-wooded grassland on seasonally saturated, black, cracking clays. Mostly occurring at low altitudes and under a drier and hotter climate than *dambos*”.



Figure 24.2. Edaphic wooded grassland with *Acacia drepanolobium* in Nairobi National Park (Kenya). Photograph by F. Gachathi (2009).



Figure 24.3. *Acacia seyal* var. *seyal* in Moyale District (Kenya) in an area with impeded drainage. Photograph by F. Gachathi (2009).



Figure 24.4. Typical East African bird species of edaphic wooded grassland within their habitat. Shell guide to East African birds (1960, reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).



Figure 24.5. Partly flooded “wooded grassland of the western Gambela region” with *Acacia nilotica*, *Acacia seyal* and *Balanites aegyptiaca*. West of Itang. Altitude approximately 450 m (September 1996). Photograph by I. Friis and Sebsebe Demissew. Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 17B. 2010.



Figure 24.6. *Acacia paolii* is common in places with black cotton soil (vertisols) that occur within *Acacia-Commiphora* bushland (Bd). In the original vegetation map of Ethiopia (Friis *et al.* 2010), areas with edaphic wooded grassland on black cotton soils that occur within areas of *Acacia-Commiphora* deciduous bushland (Bd) were not mapped separately in their “*Acacia-Commiphora* woodland and bushland proper” mapping unit; these include areas of *Acacia drepanolobium* (Friis *et al.* 2010 Fig 15E) and *Acacia paolii* (Friis *et al.* 2010 Fig 15G). Photograph by I. Friis and Sebsebe Demissew. Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 15G. 2010.



## 24.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).



Table 24. Species composition for Edaphic wooded grassland on drainage-impered or seasonally flooded soils (edaphic vegetation type, wd)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	wdet (Tanzania subtype)	wdnT (Tanzania subtype)	wdU (Uganda)	Zambia	Coast
<i>Acacia drepanolobium</i>	Somalia-Masai edaphic grassland	C	C		C	C			
<i>Acacia gerrardii</i>		f	C	f	f	f	x	f	f
<i>Acacia malacocephala</i>	Somalia-Masai edaphic grassland		x		C	f			
<i>Acacia mellifera</i>	Somalia-Masai edaphic grassland; scattered bushes in edaphic grassland of the Serengeti plains; Pleistocene clays of the Nile valley	C	C		f	C	f	f	f
<i>Acacia nilotica</i>		C	x	f	f	f	f	C	f
<i>Acacia paolii</i>		C	x						
<i>Acacia polyacantha</i>		f	C	f	f	f	C	C	f
<i>Acacia pseudofistula</i>	Somalia-Masai edaphic grassland		x		C	f			
<i>Acacia senegal</i>		C	f		f	f	x	f	f
<i>Acacia seyal</i>	Somalia-Masai edaphic grassland; Pleistocene clays of the Nile Basin	C	C	f	C	f	C	C	
<i>Acacia sieberiana</i>		f	C	f	f	f	C	C	f
<i>Acacia tanganyikensis</i>	Somalia-Masai edaphic grassland		x		f	C			
<i>Acacia tortilis</i>	Somalia-Masai edaphic grassland	f	x		f	C	f	f	f
<i>Acacia xanthophloea</i>			x	C	f	f			f
<i>Acacia zanzibarica</i>	Zanzibar-Inhambane edaphic grassland	f	f		f	f			C
<i>Albizia amara</i>	Somalia-Masai edaphic grassland	f	x	f	f	C	x	f	
<i>Albizia harveyi</i>	Somalia-Masai edaphic grassland		x	f	f	C	f	f	f
<i>Andropogon kelleri</i>	seasonally waterlogged grassland in Somalia with scattered <i>Acacia tortilis</i>		x						
<i>Aristida adscensionis</i>	seasonally waterlogged grassland in Somalia		x						
<i>Balanites aegyptiaca</i>	Sudanian grassland on shallow soil over ironstone	x	x		f	f	C	f	
<i>Balanites rotundifolia</i>		f	x				x		f
<i>Bauhinia petersiana</i>				f	f	f		C	
<i>Blepharis acanthodioides</i>	Somalia-Masai edaphic grassland		x						
<i>Borassus aethiopum</i>	Sudanian valley and floodplain edaphic grassland; Sudanian wooded edaphic grassland on pleistocene clays; palm species	C	f	f	f	f	f	f	f
<i>Bothriochloa bladhii</i>			f	x	f	f	x		
<i>Cenchrus ciliaris</i>	seasonally waterlogged grassland in Somalia		x		f	f	f		
<i>Chloris gayana</i>			x	x	f	f	f		
<i>Chloris roxburghiana</i>	seasonally waterlogged grassland in Somalia with scattered <i>Acacia tortilis</i>		x		f	f	f		
<i>Chrysopogon plumulosus</i>	seasonally waterlogged grassland in Somalia		x		f	f			
<i>Combretum adenogonium</i>		f	f	f	f	f	C	C	
<i>Commiphora schimperi</i>	Somalia-Masai edaphic grassland	f	x		f	C	f		
<i>Cynodon dactylon</i>	seasonally waterlogged grassland in Somalia		x		f	f	f		
<i>Dactyloctenium aegyptium</i>			x	x	f	f	f		
<i>Dalbergia melanoxylon</i>	Somalia-Masai edaphic grassland	f	x	f	f	C	f	f	f
<i>Diospyros kirkii</i>				f	f	f	f	C	
<i>Faidherbia albida</i>		f	f	f	f	f	f	C	f
<i>Gardenia ternifolia</i>	Sudanian grassland on shallow soil over ironstone	f	f		f	f	x		f
<i>Harrisonia abyssinica</i>		x	f	f	f	f	x	f	f
<i>Hyparrhenia rufa</i>			f	x	f	f	x		
<i>Hyphaene compressa</i>	Zanzibar-Inhambane edaphic grassland, palm species	f	f		f	f			C
<i>Hyphaene petersiana</i>	(palm species)			C	f	f		f	
<i>Hyphaene thebaica</i>	Sudanian edaphic wooded grassland on pleistocene clays; palm species	C							
<i>Kyllinga alba</i>	Somalia-Masai edaphic grassland		x						
<i>Lannea humilis</i>	Somalia-Masai edaphic grassland	f	x		f	C	x	f	
<i>Leersia hexandra</i>			f	x	f	f	x		
<i>Microchloa indica</i>	Somalia-Masai edaphic grassland		x		f	C			
<i>Oryza longistaminata</i>		C							
<i>Panicum coloratum</i>	seasonally waterlogged grassland in Somalia		x		f	f	f		
<i>Piliostigma thonningii</i>		x	f	f	f	f	C	C	f
<i>Pseudocedrela kotschy</i>	Sudanian grassland on shallow soil over ironstone	f					x		
<i>Sclerocarya birrea</i>	Somalia-Masai edaphic grassland	f	x	f	f	C	f	f	f
<i>Setaria incrassata</i>	Somalia-Masai edaphic grassland; Pleistocene clays of the Nile Basin		x	x	x	f	x		
<i>Setaria sphacelata</i>			f		f	f	x		x
<i>Sorghum purpureo-sericeum</i>	grass species that occurs in Pleistocene clays of the Nile basin		f		f	f	x		
<i>Sporobolus pyramidalis</i>			f	x	f	f	x		
<i>Terminalia spinosa</i>	Zanzibar-Inhambane edaphic grassland	f	f		f	f	f		C
<i>Terminalia stenostachya</i>				f	f	f		C	
<i>Terminalia stuhlmannii</i>	Somalia-Masai edaphic grassland		x		f	C		f	
<i>Thalia geniculata</i>		C							
<i>Themeda triandra</i>	Somalia-Masai edaphic grassland; edaphic grasslands of the Serengeti plains; Zambezian edaphic grassland		x		x	f	x		
<i>Thespesia danis</i>	Zanzibar-Inhambane edaphic grassland	f	f		f	f			C

## 25. Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bd)

### 25.1. Description

Within volumes 2 to 5, we use the synonym of “deciduous bushland (Bd)” as a synonym of “Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bd)”.

Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket is the climax vegetation type over the greater part of the Somalia-Masai floristic region. It characteristically is a dense bushland of 3 to 5 m tall with scattered emergent trees up to 9 m. Emergent species are only a few species that have well-defined trunks which carry the crown well above the main canopy; they are virtually absent from the driest areas. Most of the characteristic species of the main canopy are multiple-stemmed bushes or small bushy trees that are branched near the base. In higher rainfall areas (especially on rocky hills), the emergent trees occur closer together and are somewhat larger (but only exceptionally taller than 10 m). Some authors have categorized this physiognomic variant as woodland. Locally thickets are formed that are impenetrable. Even when canopy cover is less than 40 percent, but where grasses are inconspicuous (such as the ephemeral species of *Aristida adscensionis*, *Aristida congesta*, *Brachiaria eruciformis* and *Brachiaria leersioides* and the short-lived perennial species of *Cenchrus ciliaris*, *Chloris roxburghiana* and *Schmidtia pappophoroides*) and most of the phytomass consists of bushes (as in many places within deciduous bushland), it would be misleading to classify this vegetation as wooded grassland. In areas where rainfall is somewhat less than 250 mm per year (but probably more than 200 mm - see Somalia-Masai semi-desert grassland and shrubland [S]), the vegetation of 2 to 3 m high bushes and stunted trees (principally of *Acacia reficiens* subsp. *misera*) is intermediate between bushland and shrubland (White 1983 pp. 113 - 114).

There is appreciable variation in floristic composition, but species of *Acacia*, *Commiphora*, *Grewia* and various Capparidaceae species [e.g. *Boscia*, *Cadaba* and *Maerua*]<sup>(20)</sup> are nearly always present. The dominant *Acacia* species and some of the *Commiphora* species are spinous. Some *Commiphora* species and *Terminalia orbicularis* have several massive branches that radiate from a common base. Most species are deciduous (loosing their leaves simultaneously and usually for several weeks or months [White 1983 p. 46]). Evergreen species occur throughout, but never contribute more than 10 percent of phytomass (White 1983 p. 113).

White (1983 p. 48) describes the African pattern that where annual rainfall is between 250 and 500 mm and where there are two rainy seasons, deciduous bushland and thicket communities of regional extent (such as Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket) occur. Where annual rainfall is also between 250 and 500 mm, but falls entirely in the

20: Lind and Morrison (1974 p. 60) mention that members of the Capparidaceae family are common and include species of *Boscia*, *Cadaba* and *Maerua*. These are sometimes spiny and can be recognized by their showy flowers with many stamens and succulent, berry-like fruits on long stalks. These authors also refer to *Grewia* species that are commonly found and are often in flower (most have yellow or white flowers with many stamens, but the common *Grewia similis* has bright mauve flowers).

summer - as in the Sahel and Kalahari-Highveld floristic transition zones, grasses are favoured on sandy soils and the most widespread vegetation type becomes wooded grassland.

White (1983 p. 114) describes deciduous bushland that occurs in Tsavo National Park (between Garissa and Voi in Kenya) as typical. Most of the species that White (1983) listed as characteristic were indicator species (see also section 3.2). Only four species (including three climbers) were also listed as characteristic species for evergreen bushland (Be): *Cissus quadrangularis* and *Cissus rotundifolia* (climbers listed for this vegetation type occurring in the Lake Victoria region), *Grewia tembensis* (listed as a smaller bush and shrub for deciduous bushland and as a large bush in East African evergreen bushland) and *Sarcostemma viminale* (a climber listed for this vegetation type occurring in East Africa).

The indicator species can be further categorized in: (i) characteristic species of the main canopy; (ii) emergent species; (iii) smaller bushes and shrubs; (iv) succulents; and (v) climbers.

- Characteristic species of the main canopy include<sup>(21)</sup>: *Acacia bussei*, *Acacia mellifera* (also scattered in Somalia-Masai edaphic grassland), *Acacia nilotica*, *Acacia reficiens*, *Acacia thomasii*, *Balanites rotundifolia*, *Boscia coriacea* (evergreen, often one of the few species that are not eliminated by elephants in severely degraded bushland), *Boswellia neglecta*, *Cadaba farinosa*, *Cadaba heterotricha*, *Cassia abbreviata*, *Commiphora africana*, *Commiphora campestris*, *Commiphora edulis*, *Commiphora erythraea*, *Commiphora mollis*, *Commiphora schimperi* (also scattered in Somalia-Masai edaphic grassland), *Cordia monoica*, *Cordia sinensis*, *Dobera glabra*, *Dobera loranthifolia* (evergreen), *Euphorbia scheffleri*, *Givotia gosai*, *Hymenodictyon parvifolium*, *Lannea alata*, *Lannea triphylla*, *Platycelyphium voense*, *Premna hildebrandtii*, *Salvadora persica* (evergreen), *Sesamothamnus rivaie*, *Sterculia africana*, *Sterculia rhynchocarpa*, *Sterculia stenocarpa*, *Terminalia orbicularis*, *Terminalia parvula* and *Thylachium thomasii*.
- Emergent species include *Acacia tortilis* (also scattered in Somalia-Masai edaphic grassland), *Adansonia digitata* (often only 8 m tall with a short but massive trunk), *Delonix elata*, *Euphorbia robecchii* (a candelabra-like succulent), *Melia volkensii* (this species persists longer than most woody species in degraded bushland) and *Terminalia spinosa*.
- Smaller bushes and shrubs include *Bauhinia taitensis*, *Bridelia taitensis*, *Caesalpinia trochae*, *Carphalea glaucescens*, *Caucanthus albidus*, *Combretum aculeatum*, *Ecbolium amplexicaule*, *Erythrochlamys spectabilis*, *Grewia fallax*, *Grewia tembensis*, *Grewia tenax*, *Grewia villosa*, *Maerua deinhardtiorum*, *Premna resinosa*, *Sericocomopsis hildebrandtii* and *Sericocomopsis pallida*.
- Succulents include *Adenium obesum*, *Calyptrorhiza somalensis*, *Calyptrorhiza taitensis*, *Euphorbia grandicornis*, *Eu-*

21. White (1983 p. 114) did not list *Acacia senegal* among the characteristic species of the main canopy. However, this is probably an oversight since *Acacia senegal* is listed as one of the dominant species of deciduous bushland in Marsabit district (White 1983 p. 121). *Acacia senegal* var. *kerensis* is a typical constituent of deciduous bushland and the main producer of gum arabic in Kenya. The variety of *Acacia senegal* var. *senegal* is a typical variety of biotic Acacia wooded grassland (We; F. Gachathi, pers. comm.).

*phorbia nyikae* (a candelabra-like succulent that is more restricted than *Euphorbia robechii*), *Euphorbia robecchii* (a candelabra-like succulent that also is an emergent), *Euphorbia quinquecostata* (a candelabra-like succulent that is more restricted than *Euphorbia robechii*) and *Monadenium invenustum*.

- Climbers include *Adenia globosa* (a climber with enormous half-submerged water storing tubers), *Gerrardanthus lobatus*, *Kedrostis gijef*, *Pergularia daemia*, *Pyrenacantha malvifolia* (a climber with enormous half-submerged water storing tubers, often one of the few remaining species in severely degraded bushland) and *Thunbergia guerkeana*.

## 25.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).





Figure 25.1. *Acacia-Commiphora* deciduous bushland 57 km from Konso on route to Yabelo (Ethiopia). Photograph by Sebsebe Demissew (May 2008).



Figure 25.2. *Acacia-Commiphora* bushland on fine-grained reddish sand. The photograph was taken near Yabelo (Ethiopia) after a rainy season with above-average rainfall. Altitude approximately 1600 metres. Photograph by I. Friis and Sebsebe Demissew (November 1997). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 15B. 2010.



Figure 25.3. Partly exposed tubers of *Pyrenacantha malvifolia* in the underground of *Acacia-Commiphora* deciduous bushland (Bd), here partly on black cotton soil (vertisol). Near Sof Omar (Ethiopia). Altitude approximately 1500 metres. White (1983 p. 114) described this species as a climber with enormous half-submerged water storing tubers and often one of the few remaining species in severely degraded Somalia-Masai *Acacia-Commiphora* deciduous bushland. Photograph by I. Friis and Sebsebe Demissew (October 1984). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 15H. 2010.



Figure 25.4. *Acacia-Commiphora* deciduous bushland in Garbatula (Kenya). The species in the foreground is *Commiphora holtziana*. The emergent tree at the right is *Acacia tortilis*. Photograph by F. Gachathi (2011).

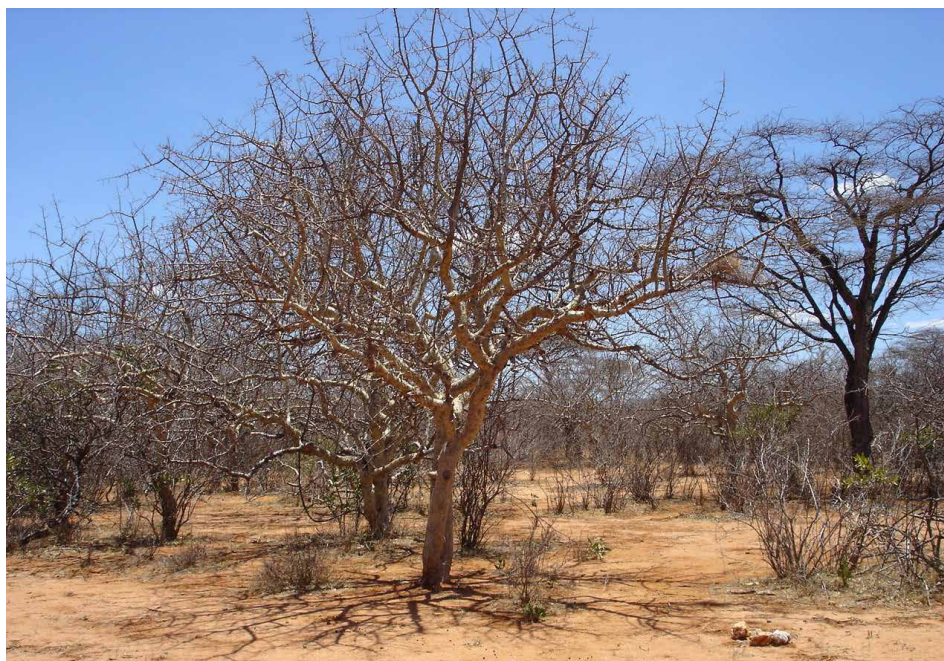


Figure 25.5. *Commiphora africana* is a typical species of *Acacia-Commiphora* deciduous bushland. The image above shows the species during the dry season (Garbatula, Kenya, photograph taken in 2011), whereas the image below shows the species during the wet season (Samburu district, Kenya, photograph taken in 2009). Photographs by F. Gachathi.







Figure 25.6. *Commiphora holtziana* produces opoponax (hagar). This species can dominate large sections of *Acacia-Commiphora* bushland in Kenya as in Garbatula shown here. Photograph by F. Gachathi (2011).



Figure 25.7. *Acacia senegal* var. *kerensis* is a typical constituent of *Acacia-Commiphora* deciduous bushland and thicket, as in the thicket shown here from Isiolo District (Kenya). This species is the main producer of gum arabic in Kenya. Another variety of this species, *Acacia senegal* var. *kerensis*, is typical of biotic *Acacia* wooded grassland (We, see Volume 3). Photograph by F. Gachathi (2008).



Figure 25.8. *Acacia reficiens* ssp. *misera* can form almost uniform stands as shown here in Garbatula (Kenya).



Figure 25.9. White (1983 p. 114) describes that *Acacia reficiens* ssp. *misera* is the typical stunted tree species of vegetation that is intermediate between bushland and shrubland (in VECEA, this vegetation type was mapped as the “stunted bushland” subtype of Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket [Bds]). Photographs taken by F. Gachathi (2011).



Table 25. Species composition for Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bd)

SPECIES	Regional status	Ethiopia	Kenya	Kenya (BdsK subtype)	Tanzania	Uganda	Uganda (BdvU subtype)	Uganda (BdrU subtype)
<i>Acacia bussei</i>	indicator species	C	x	x	f		C	
<i>Acacia mellifera</i>	indicator species	x	x	x	x	C	C	C
<i>Acacia nilotica</i>	indicator species	x	x	x	f	C	x	x
<i>Acacia reficiens</i>	indicator species	C	x	x	f	C	C	
<i>Acacia thomasii</i>	indicator species		x					
<i>Acacia tortilis</i>	indicator species	C	x	x	x	C	C	C
<i>Adansonia digitata</i>	indicator species	f	x		x			
<i>Adenia globosa</i>	indicator species	x	x		f			
<i>Adenium obesum</i>	indicator species	x	x			x	x	
<i>Balanites rotundifolia</i>	indicator species	C	x	x		C	x	
<i>Bauhinia taitensis</i>	indicator species		x					
<i>Boscia coriacea</i>	indicator species	x	x	x	f	f		
<i>Boswellia neglecta</i>	indicator species	C	x	C	f	x		
<i>Bridelia taitensis</i>	indicator species		x					
<i>Cadaba farinosa</i>	indicator species	f	x	x	f	x	x	x
<i>Cadaba heterotricha</i>	indicator species	x	x					
<i>Caesalpinia trothae</i>	indicator species	x	x		f			
<i>Calyptrotheca somalensis</i>	indicator species	x	x					
<i>Calyptrotheca taitense</i>	indicator species		x					
<i>Carphalea glaucescens</i>	indicator species	x	x		f			
<i>Cassia abbreviata</i>	indicator species		x		f			
<i>Caucanthus albidus</i>	indicator species	x	x					
<i>Combretum aculeatum</i>	indicator species	C	x		f	f		
<i>Commiphora africana</i>	indicator species	x	x	x	f	C	x	x
<i>Commiphora campestris</i>	indicator species	C	x		f	x	C	
<i>Commiphora edulis</i>	indicator species	C	x		f	C		
<i>Commiphora erythraea</i>	indicator species	x	x	x				
<i>Commiphora mollis</i>	indicator species		x		f			
<i>Commiphora schimperi</i>	indicator species	x	x		f	C		
<i>Cordia monoica</i>	indicator species	x	x		f	f		
<i>Cordia sinensis</i>	indicator species	x	x	x	x	f	x	
<i>Delonix elata</i>	indicator species	x	x	x	f	f		
<i>Dobera glabra</i>	indicator species	x	x	x	f	f		
<i>Dobera loranthifolia</i>	indicator species		x		f			
<i>Ecbolium amplexicaule</i>	indicator species		f		x			
<i>Erythrochlamys spectabilis</i>	indicator species	x	x					
<i>Euphorbia grandicornis</i>	indicator species		x			x	x	
<i>Euphorbia invenusta</i>	indicator species		f					
<i>Euphorbia nyikae</i>	indicator species		x		x			
<i>Euphorbia quinquecostata</i>	indicator species		x		f			
<i>Euphorbia robecchii</i>	indicator species	x	x		f			
<i>Euphorbia scheffleri</i>	indicator species	x	x		f			
<i>Gerrardanthus lobatus</i>	indicator species		x		f	f		
<i>Givotia gosai</i>	indicator species	x	x					
<i>Grewia arborea</i>	indicator species		x		f	f		
<i>Grewia tenax</i>	indicator species	x	x	x	f	x	C	
<i>Grewia villosa</i>	indicator species	x	x	x	f	x	x	

SPECIES	Regional status	Ethiopia	Kenya	Kenya (Bdsk subtype)	Tanzania	Uganda	Uganda (BdvU subtype)	Uganda (BdrU subtype)
<i>Hymenodictyon parvifolium</i>	indicator species		x		f	f		
<i>Kedrostis gijef</i>	indicator species		x		f			
<i>Lannea alata</i>	indicator species		x		f			
<i>Lannea triphylla</i>	indicator species	x	x		f	C	C	C
<i>Maerua deinhardtiorum</i>	indicator species	x	x					
<i>Melia volkensii</i>	indicator species	x	x		f			
<i>Pergularia daemia</i>	indicator species	x			f			
<i>Platycelyphium voense</i>	indicator species	x	x		f			
<i>Premna hildebrandtii</i>	indicator species		x		f			
<i>Premna resinosa</i>	indicator species	x	x		f	f		
<i>Pyrenacantha malvifolia</i>	indicator species	x	x		f			
<i>Salvadora persica</i>	indicator species	x	x	x	x	f		
<i>Sericocomopsis hildebrandtii</i>	indicator species	x	x	x	f	x		
<i>Sericocomopsis pallida</i>	indicator species	x	x	x	f			
<i>Sesamothamnus rivae</i>	indicator species	x	x		f	x		
<i>Sterculia africana</i>	indicator species	x	x		f			
<i>Sterculia rynchocarpa</i>	indicator species	x	f		f	x		
<i>Sterculia stenocarpa</i>	indicator species	x	x		f	f		
<i>Terminalia orbicularis</i>	indicator species	C	x					
<i>Terminalia parvula</i>	indicator species		x					
<i>Terminalia spinosa</i>	indicator species	x	x	x	f	f		
<i>Thilachium thomasi</i>	indicator species		x					
<i>Thunbergia guerkeana</i>	indicator species		x		f			
<i>Cissus quadrangularis</i>	characteristic species		x		x	x	x	
<i>Cissus rotundifolia</i>	characteristic species	x	x		f	x	x	
<i>Grewia tembensis</i>	characteristic species	x	x	x				
<i>Sarcostemma viminalis</i>	characteristic species	x	f			x	x	
<i>Acacia asak</i>		x						
<i>Acacia brevispica</i>		x	x	x	f	C	C	
<i>Acacia drepanolobium</i>		C	x	x	x	x		x
<i>Acacia gerrardii</i>		f	x		f	x		
<i>Acacia hockii</i>		f	x		f	C		
<i>Acacia lahai</i>		x	x		f	f		
<i>Acacia oerfota</i>		x	x	x	f	f	C	
<i>Acacia paolii</i>		x	x	x				
<i>Acacia senegal</i>		x	x	x	f	C		
<i>Acacia seyal</i>		x	x		x	C	C	C
<i>Albizia amara</i>		f	x	x	f	C		
<i>Albizia anthelmintica</i>		x	x		f	x	x	
<i>Allophylus rubifolius</i>		x	x		f	f		
<i>Balanites aegyptiaca</i>		C	x	x	f	C	x	x
<i>Balanites glabra</i>		x	x		f			
<i>Berchemia discolor</i>		x	x		f	f		
<i>Boscia angustifolia</i>		x	x		f	x		
<i>Boscia salicifolia</i>		x	x		f	f		
<i>Boswellia microphylla</i>		C	x	x				
<i>Boswellia rivae</i>		x	x					



SPECIES	Regional status	Ethiopia	Kenya	Kenya (Bdsk subtype)	Tanzania	Uganda	Uganda (BdvU subtype)	Uganda (BdrU subtype)
<i>Calotropis procera</i>		x	x	x	f	f		
<i>Canthium lactescens</i>		x	x		f	f		
<i>Capparis tomentosa</i>		C	x		f	f		
<i>Carissa spinarum</i>		x	x		f	f		
<i>Commiphora habessinica</i>		x	x		x	C	x	
<i>Commiphora myrrha</i>		C	x					
<i>Commiphora rostrata</i>		C	x					
<i>Dichrostachys cinerea</i>		x	f		f	C		
<i>Erythrina burtii</i>			x		f			
<i>Erythrina melanacantha</i>		x	x		f			
<i>Euclea divinorum</i>		x	x		f	f		
<i>Euphorbia candelabrum</i>		x	x		x	C	C	
<i>Euphorbia tirucalli</i>		x	x		x	f		
<i>Faidherbia albida</i>		x	x		f	f		
<i>Gardenia volkensii</i>		x	x		f	f		
<i>Grewia bicolor</i>		x	x		f	f	x	
<i>Grewia similis</i>		f	x		f	x	C	
<i>Harrisonia abyssinica</i>		x	x		f	f		
<i>Hyphaene compressa</i> (palm species)		x	x	x	f			
<i>Hyphaene thebaica</i> (palm species)		x	f	x				
<i>Lannea humilis</i>		x	f		f	C	C	C
<i>Lannea rivae</i>		x	x		f			
<i>Lawsonia inermis</i>		x	x	x	f	f		
<i>Maerua decumbens</i>		x	x		f	f		
<i>Maytenus senegalensis</i>		x	x		f	f		
<i>Opilia campestris</i>		x	x		f			
<i>Ormocarpum kirkii</i>			x		f			
<i>Ormocarpum trachycarpum</i>		x	x		f	f		
<i>Ormocarpum trichocarpum</i>		x	x		f	x		
<i>Otostegia integrifolia</i>		x						
<i>Ozoroa insignis</i>		x	f		f	x		
<i>Phoenix dactylifera</i>			x		f			
<i>Plectranthus barbatus</i>		x	f		f	C	C	
<i>Psydrax schimperiana</i>		x	x		f	f		
<i>Rhus natalensis</i>		x	x	x	f	x	x	
<i>Sclerocarya birrea</i>		f	x		f	C		
<i>Senna alexandrina</i>		x	x					
<i>Steganotaenia araliacea</i>		x	x		f	x		
<i>Tarenna graveolens</i>		x	f		f	x		
<i>Terminalia brownii</i>		x	f		f	C		
<i>Terminalia prunioides</i>		x	x		f			
<i>Ximenia americana</i>		x	x		f	x		
<i>Zanthoxylum chalybeum</i>		x	x	x	f	C	x	
<i>Ziziphus mauritiana</i>		x	x		f	f		
<i>Ziziphus mucronata</i>		x	x		f	f		
<i>Ziziphus spina-christi</i>		x	x		f	f		

## 26. Evergreen and semi-evergreen bushland and thicket (synonym: evergreen bushland, Be)

### 26.1. Description

Within volumes 2 to 5, we use the synonym of “evergreen bushland (Be)” as a synonym of “evergreen and semi-evergreen bushland and thicket (Be)”.

White (1983) describes evergreen and semi-evergreen bushland and thickets within the descriptions of two floristic regions: (i) the Somalia-Masai regional centre of endemism (‘East African evergreen and semi-evergreen bushland and thicket’); and (ii) the Lake Victoria regional mosaic (‘evergreen and semi-evergreen bushland and thicket and derived communities’).

Evergreen and semi-evergreen bushland and thicket occurs on the drier slopes of mountains and upland areas in East Africa which rise from the lowlands from the Somalia-Masai region all the way from central Tanzania to Eritrea (and beyond). It often forms an ecotone between Afromontane forest (especially Afromontane single-dominant *Juniperus procera* forest [Fbj]) and deciduous bushland (Bd) - this pattern of occurrence can be clearly observed in northern Kenya such as at on the lower slopes of Mt. Marsabit (2° 16' N, 37° 57' E). The mean annual rainfall is mostly between 500 and 850 mm and is irregularly distributed throughout the year but with two main peaks (White 1983 pp. 48 and 115).

Evergreen bushland varies greatly in composition and richness, but certain species that are nearly always present include *Acokanthera schimperi*, *Carissa spinarum*, *Dodonaea viscosa*, *Euclea divinorum*, *Euphorbia candelabrum*, *Olea europaea* subsp. *cuspidata* (synonym: *Olea africana*), *Tarchonanthus camphoratus* (especially in disturbed areas), *Vepris simplicifolia* (synonym: *Teclea simplicifolia*) together with other species of *Acokanthera*, *Aloe*, *Euclea*, *Euphorbia*, *Sansevieria* and *Vepris*. Succulents such as *Dracaena ellenbeckiana* and *Euphorbia candelabrum* that are present in evergreen bushland are absent from Afromontane single-dominant *Juniperus procera* forest (Fbj, White 1983 p. 115).

Evergreen bushland (in mosaic with Lake Victoria *Euphorbia dawei* scrub forest [fe, see Volume 2] that is edaphically restricted to rocky slopes) probably represents the climax vegetation of large parts of the Lake Victoria region. This evergreen bushland variant is floristically similar but also floristically poorer than the vegetation type with the same name that occurs in the Somalia-Masai region. The principal bushy species include *Allophylus africanus*, *Azima tetracantha*, *Carissa spinarum* (also listed as characteristic in East Africa), *Capparis fascicularis* (listed as a characteristic climber in East Africa), *Capparis tomentosa*, *Erythrococca bongensis*, *Grewia bicolor*, *Maerua triphylla*, *Olea europaea* subsp. *cuspidata* (synonym: *Olea africana*, also listed as characteristic in East Africa), *Psydrax schim-*

**periana**, **Rhus natalensis** (also listed as characteristic in East Africa), **Tarenna graveolens** and **Turraea nilotica**.

Annual rainfall is higher in places where evergreen bushland occurs in the Lake Victoria region (850 mm to 1000 mm) than those places where it occurs in the Somalia-Masai region (500 to 850 mm; White 1983 pp. 48 and 182).

Where evergreen bushland is degraded (as a result from grazing), various *Acacia* species invade and **biotic Acacia wooded grassland (We)** becomes established. This vegetation type forms an alternative steady state of potential natural vegetation to evergreen bushland (*i.e.* it is possible for both types of potential natural vegetation to become established in the areas where they are mapped separately).

The grasslands of the Loita and other plains that occur in Narok district (including parts of the Masai-Mara reserve) are similar in grass species composition as the edaphic grasslands on volcanic soils of the Serengeti plains (gy, see Volume 5). However, these grasslands in Narok district are secondary to evergreen bushland as a result from fire and browsing (White 1983 p. 127). Areas capable of supporting evergreen bushland in Nairobi National Park have been converted to grassland as a result from browsing, grazing and fire (White 1983 p. 116).

White (1983) describes relatively undisturbed evergreen bushland (locally impenetrable) that occurred near Nairobi between 1875 and 2080 m. Most of the species that White (1983) listed as characteristic were indicator species (see also section 4.3). Only two species were also listed as characteristic species for deciduous bushland (Bd): *Grewia tembensis* (listed as a smaller bush and shrub for deciduous bushland and thicket, and as a large bush in East African evergreen bushland) and *Sarcostemma viminalis* (a succulent climber).

The indicator species can be further categorized in: (i) characteristic species of the main canopy; (ii) other large bushes; (iii) scattered emergents; (iv) shrubs; (v) climbers; and (vi) scattered stunted individuals that indicate the transition to Afromontane single-dominant *Juniperus procera* forest (Fbj).

- Characteristic species of the main canopy (3 to 7 m) include ***Acokanthera schimperi***, ***Euclea divinorum***, ***Gnidia subcordata***, ***Olea europaea* subsp. *cuspidata*** (synonym: *Olea africana*], also listed as characteristic species for the Lake Victoria region), ***Tarchonanthus camphoratus*** (especially in disturbed areas) and ***Vepris simplicifolia***. (White (1983) did not list *Carissa spinarum*, but this could be an omission).
- Other large bushes include ***Canthium keniense***, ***Croton dichogamus***, ***Dodonaea viscosa***, ***Dombeya burgessiae***, ***Grewia similis***, ***Maytenus heterophylla*** and ***Rhus natalensis*** (also listed as characteristic species for the Lake Victoria region).
- ***Euphorbia candelabrum*** (a cactoid stem-succulent) occurs throughout as a scattered emergent up to 9 m tall. This species was also listed as a characteristic species for the Lake Victoria region.

- Shrubs include *Aspilia mossambicensis*, *Psiadia punctulata*, *Tinnea aethiopica* and *Turraea mombassana*.
- Climbers include *Capparis fascicularis* (also listed as characteristic species for the Lake Victoria region), *Pterolobium stellatum* and *Scutia myrtina*.
- Scattered stunted individuals that indicate the transition to Afromontane single-dominant *Juniperus procera* forest (Fbj) appear at higher altitudes and include *Calodendrum capense*, *Cussonia holstii*, *Drypetes gerrardii*, *Elaeodendron buchananii*, *Juniperus procera* (evergreen bushland could be the original habitat of this species [White 1983 p. 165]) and *Schrebera alata*.





Figure 26.1. Evergreen thicket in Queen Elizabeth National Park (Uganda). Emergent *Euphorbia candelabrum* covered by climbers can be seen in various places. Photograph by M. Namaganda (June 2008).



Figure 26.2. Evergreen and semi-evergreen bushland next to a remnant of Afromontane single-dominant *Juniperus procera* forest (Fbj). Near Arero (Ethiopia). Approximate altitude 1800m. Photograph by I. Friis and Sebsebe Demissew (September 2002). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 23A. 2010.



Figure 26.3. Stands of *Dracaena ombet* subsp. *ombet* in *Acacia*-dominated bushland below remnants of Afromontane single-dominant *Juniperus procera* forest (Fbj). Between Wukro and Berahile (Ethiopia). Approximate altitude 1700 m. Photograph by I. Friis and Sebsebe Demissew (October 2009). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 23B. 2010.



Figure 26.4. Regrowth of *Tarcho-  
nanthus camphoratus* in evergreen  
bushland in a transition zone between  
*Acacia-Commiphora* deciduous  
bushland and Afromontane single-  
dominant *Juniperus procera* forest  
(Fb). Between Wukro and Berahile  
(Ethiopia). Approximate altitude 2000  
m. (October 2009). Photograph by I.  
Friis and Sebsebe Demissew. Repro-  
duced from Biologiske Skrifter of the  
Royal Danish Academy of Sciences and  
letters, Vol. 58, Fig 23D. 2010.



Figure 26.5. Evergreen bushland and  
thicket in Biharagu (Rwanda). Photo-  
graph taken by E. Munyaneza (Octo-  
ber 2009).

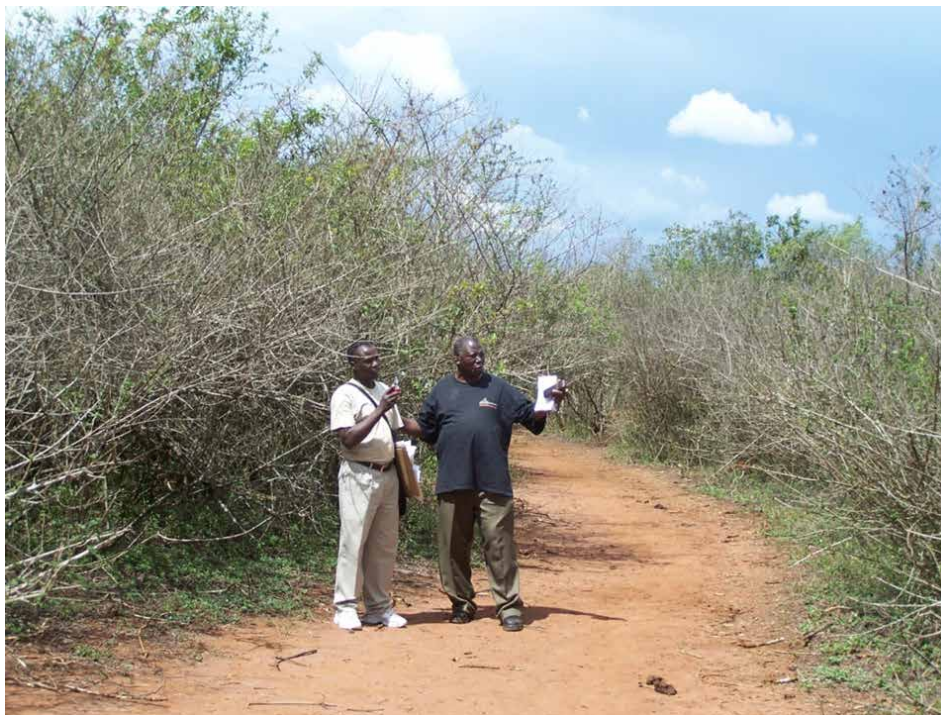


Figure 26.6. Evergreen bushland  
was the original vegetation type of  
most of the Akagera National Park  
(Rwanda). Photograph by V. Minani  
(March 2007).





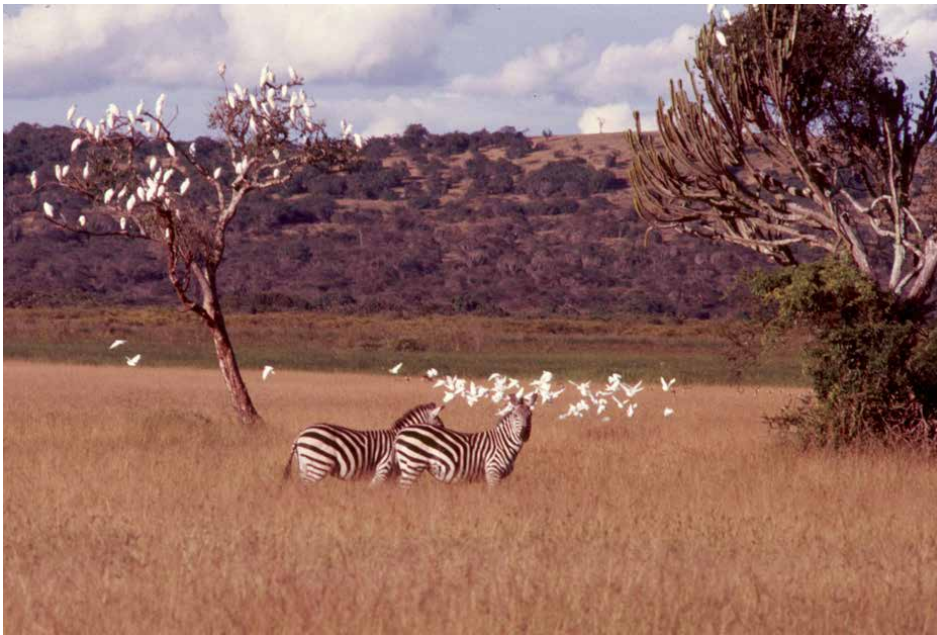


Figure 26.7. As a result from grazing, the original evergreen bushland of Akagera national park (Rwanda) has changed to the alternative steady state of biotic Acacia wooded grass-land (We). Climbers growing on *Euphorbia candelabrum* (right) can initiate the vegetation succession to evergreen bushland (see also Lebrun [1947] and White [1983 p. 183]; Photograph by D. König (September 1987).



Figure 26.8. Evergreen bushland in the Maasai Mara (original mapping unit 24). The photograph shows *Diospyros abyssinica* together with typical evergreen bushland species of *Euclea divinorum*, *Olea europaea* ssp. *cuspidata* (synonym: *Olea africana*). Person: C.G. Trapnell. Photography by E.C. Trump.

## 26.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 26. Species composition for Evergreen and semi-evergreen bushland and thicket (synonym: evergreen bushland, Be)

SPECIES	Regional status	Ethiopia	Kenya (BeeK subtype)	Kenya (BewK subtype)	Rwanda	Tanzania	Uganda (BemU subtype)	Uganda (BedU subtype)
<i>Acokanthera schimperi</i>	indicator species	C	x	x	x	f	f	f
<i>Allophylus africanus</i>	indicator species	f	f	x	f	f	x	C
<i>Aloe kedongensis</i>	indicator species		x					
<i>Aspilia mossambicensis</i>	indicator species	f	f	f		f	f	f
<i>Azima tetracantha</i>	indicator species			x	x		f	f
<i>Canthium keniense</i>	indicator species		x					
<i>Capparis fascicularis</i>	indicator species	f	x	x	x	f	f	x
<i>Capparis tomentosa</i>	indicator species	f	x	x	C	f	f	x
<i>Carissa spinarum</i>	indicator species	f	x	x	C	x	x	x
<i>Croton dichogamus</i>	indicator species	f	x	x	x	x	f	
<i>Dodonaea viscosa</i>	indicator species	C	x	x	f	f	f	f
<i>Dombeya burgessiae</i>	indicator species		x	f	f	f	f	
<i>Dracaena ellenbeckiana</i>	indicator species	C	x	f		f	f	
<i>Erythrococca bongensis</i>	indicator species	f	f	x	x	f	f	
<i>Euclea divinorum</i>	indicator species	C	x	x	x	x	x	f
<i>Euphorbia candelabrum</i>	indicator species	f	x	x	f	x	x	C
<i>Gnidia subcordata</i>	indicator species		x	x		f	f	
<i>Grewia bicolor</i>	indicator species	f	x	x		f	f	f
<i>Grewia similis</i>	indicator species	x	x	x	C	x	C	x
<i>Maerua triphylla</i>	indicator species	f	x	x	x	f	f	
<i>Maytenus heterophylla</i>	indicator species	f	x	f	x	f	f	
<i>Olea europaea</i>	indicator species	C	x	x	C	x	f	f
<i>Psiadia punctulata</i>	indicator species	x	x			f		
<i>Psydrax schimperiana</i>	indicator species	f	x	x	x	f	f	f
<i>Pterolobium stellatum</i>	indicator species	f	x	x	f	f	f	f
<i>Rhus natalensis</i>	indicator species	f	x	x	x	x	x	f
<i>Scutia myrtina</i>	indicator species	f	x	x	x	f	x	f
<i>Tarchonanthus camphoratus</i>	indicator species	C	x	x		f	f	
<i>Tarenna graveolens</i>	indicator species	x	x	x	x	C	f	x
<i>Tinnea aethiopica</i>	indicator species	f	x	x		f	f	x
<i>Turraea mombassana</i>	indicator species	x	x			f		
<i>Turraea nilotica</i>	indicator species	f	f	x		f		
<i>Vepris simplicifolia</i>	indicator species	f	x	x		x		
<i>Vernonia brachycalyx</i>	indicator species	f	f	x	x	f	C	f
<i>Acacia drepanolobium</i>	characteristic species	f	C	f		f	f	f
<i>Acacia gerrardii</i>	characteristic species	f	C	x	f	x	f	x
<i>Acacia hockii</i>	characteristic species	f	C	x	f	f	f	x
<i>Acacia kirkii</i>	characteristic species		x	x	f	f	f	f
<i>Acacia senegal</i>	characteristic species	f	x	x	f	f	f	C
<i>Acacia seyal</i>	characteristic species	f	x	C		f	f	f
<i>Calodendrum capense</i>	characteristic species		x	f		f	f	f
<i>Cissus quadrangularis</i>	characteristic species		x	x	x	f	f	
<i>Cissus rotundifolia</i>	characteristic species	f	f	x		f	x	x
<i>Cussonia holstii</i>	characteristic species	C	x	x	x	f	f	f
<i>Drypetes gerrardii</i>	characteristic species		x	f	C	f	f	
<i>Elaeodendron buchananii</i>	characteristic species	f	x	f	x	x	f	f
<i>Grewia tembensis</i>	characteristic species	x	x	f				

SPECIES	Regional status	Ethiopia	Kenya (BeeK subtype)	Kenya (BewK subtype)	Rwanda	Tanzania	Uganda (BemU subtype)	Uganda (BedU subtype)
<i>Juniperus procera</i>	characteristic species	C	x	f		f	f	f
<i>Sarcostemma viminale</i>	characteristic species	f	f	f	x			
<i>Schrebera alata</i>	characteristic species	C	x	f	x	f	f	f
<i>Acacia brevispica</i>		f	C	C	x	x	C	C
<i>Acacia lahai</i>		f	x	x		f	f	f
<i>Acacia mellifera</i>	not characteristic	f	C	f		f	f	f
<i>Acacia nilotica</i>	not characteristic	f	x	f		f	f	x
<i>Acacia polyacantha</i>		f	x	x	f	f	f	f
<i>Acokanthera oppositifolia</i>	characteristic genus		f	x				
<i>Albizia amara</i>	not characteristic	f	x	f	f	f	f	x
<i>Albizia coriaria</i>		f	f	C		f	x	f
<i>Albizia zygia</i>			f	f		f	x	x
<i>Allophylus rubifolius</i>		f	x	x	x	f	f	f
<i>Annona senegalensis</i>		f	x	x	f	f	f	f
<i>Antidesma venosum</i>		f	f	x		f	x	f
<i>Apodytes dimidiata</i>		f	x	x	x	f	f	f
<i>Balanites aegyptiaca</i>		f	x	f	f	f	f	x
<i>Berberis holstii</i>		C	f	f		f	f	f
<i>Berchemia discolor</i>		C	f	f		f	f	f
<i>Boscia angustifolia</i>		f	f	f	x	f	f	x
<i>Bridelia micrantha</i>		f	x	x	f	f	f	f
<i>Bridelia scleroneura</i>		f	f	f		f	x	C
<i>Cadaba farinosa</i>	not characteristic	f	f	x	x	f	f	f
<i>Canthium lactescens</i>		x	x	f	x	f	C	f
<i>Catha edulis</i>		C	x	f	f	f	f	f
<i>Clausena anisata</i>		f	x	x	x	f	f	f
<i>Clerodendrum myricoides</i>		x	x	x	x	f	f	f
<i>Combretum molle</i>		f	x	f	x	f	f	f
<i>Commiphora africana</i>	not characteristic	x	f	f	f	f	f	x
<i>Cordia monoica</i>	not characteristic	f	x	x		x	f	f
<i>Crotalaria agatiflora</i>		f	x	x	f	f	f	f
<i>Croton macrostachyus</i>		f	x	x	x	f	f	f
<i>Cussonia arborea</i>		f	x	x	x	f	f	f
<i>Dichrostachys cinerea</i>		f	f	x	f	f	f	x
<i>Dombeya rotundifolia</i>		x	x	x	f		f	f
<i>Dovyalis abyssinica</i>		f	x	x		f	f	f
<i>Erythrina abyssinica</i>		f	x	x	f	f	f	f
<i>Euclea racemosa</i>	characteristic genus	C	x	x	x	C	x	f
<i>Euphorbia tirucalli</i>		x	x	x	x	f	x	x
<i>Faurea rochetiana</i>		f	x	f	x	f	f	f
<i>Faurea saligna</i>			x	x	f	f	f	f
<i>Ficus glumosa</i>		f	x	x	f	f	f	f
<i>Flacourtia indica</i>		f	x	x	x	f	f	f
<i>Gardenia ternifolia</i>		f	x	x	f	f	f	f
<i>Grewia mollis</i>		f	x	x	f	f	C	C
<i>Harrisonia abyssinica</i>		f	x	x	x	f	x	C
<i>Indigofera swaziensis</i>			x	x		f	f	f



SPECIES	Regional status	Ethiopia	Kenya (BeeK subtype)	Kenya (BewK subtype)	Rwanda	Tanzania	Uganda (BemU subtype)	Uganda (BedU subtype)
<i>Lannea fulva</i>			f	f	x	f	f	f
<i>Lannea humilis</i>	not characteristic	f	x	f	f	f	f	x
<i>Lannea schweinfurthii</i>		f	x	f	f	x	f	x
<i>Lecaniodiscus fraxinifolius</i>		f	x	x		f	f	f
<i>Lippia kituiensis</i>			x	x		f		
<i>Maytenus senegalensis</i>		f	x	f	x	f	f	f
<i>Maytenus undata</i>		f	x	f	x	f	f	f
<i>Oncoba spinosa</i>		f	x	x		f	f	f
<i>Ormocarpum kirkii</i>			x	f		f		
<i>Osyris lanceolata</i>		f	x	f	x	f	f	f
<i>Ozoroa insignis</i>		f	x	x	f	f	f	f
<i>Pappea capensis</i>		C	x	x	x	x	f	f
<i>Pavetta crassipes</i>		f	x	x		f	f	f
<i>Pistacia aethiopica</i>		C	x	f		f	f	f
<i>Pittosporum viridiflorum</i>		C	x	f	x	f	f	f
<i>Rhamnus staddo</i>		f	x	f	x	f	f	f
<i>Rhoicissus revoilii</i>		f	f	x	x	f	f	f
<i>Rhoicissus tridentata</i>		f	x	x	x	f	x	x
<i>Rhus vulgaris</i>		f	x	x	x	f	f	f
<i>Senna didymobotrya</i>		x	x	f	f	f	f	f
<i>Solanecio cydoniifolius</i>			x	f	x	f	f	f
<i>Solanecio mannii</i>		f	x	f	x	f	f	f
<i>Steganotaenia araliacea</i>		f	f	x	f	f	f	x
<i>Stereospermum kunthianum</i>		f	x	x		f	f	x
<i>Strychnos henningsii</i>		f	x	f		x	f	f
<i>Terminalia brownii</i>		f	x	x		f	f	f
<i>Tetradenia riparia</i>		f	x	x	f			
<i>Vangueria apiculata</i>		f	x	x	x	f	x	f
<i>Vangueria infausta</i>			x	x	x	f	f	f
<i>Vangueria madagascariensis</i>		x	x	x		f	x	f
<i>Vepris nobilis</i>	characteristic genus (synonym: Teclea)	f	x	x	x	C	C	f
<i>Vepris trichocarpa</i>	characteristic genus (synonym: Teclea)		x		x	C		x
<i>Zanthoxylum chalybeum</i>		f	x	f	x	f	f	x
<i>Zanthoxylum usambarense</i>		C	f	f	f	f		
<i>Ziziphus abyssinica</i>		f	x	x	f	f	f	C
<i>Ziziphus mucronata</i>		f	x	x	f	x	f	f
<i>Ziziphus pubescens</i>		f	x	x		f	x	f

## 27. Montane Ericaceous belt (easily identifiable type, E)

### 27.1. Description

White (1983) refers to Afromontane evergreen bushland and thickets that occur on most of the higher African mountains and that characteristically occupy a large part of the Ericaceous mountain belt. They are also found on the crests and summits of smaller mountains (especially those that are situated close to the ocean or a large lake) or locally on shallow soils within the Afromontane forest belt. Where the ground is not very rocky and has been protected for several years, such as on wetter mountains as the Ruwenzori Mts., almost impenetrable thickets of 3 to 13 m are formed. On drier and rocky slopes, the vegetation is an open community of bushes that is often discontinuous and merges into Afromontane shrubland (see below). Afromontane evergreen bushland and thicket varies greatly in floristic composition, but species of the *Blaeria*, *Erica* and *Vaccinium* Ericaceae genera are nearly always present and sometimes exclusively dominant (White 1983 p. 167 - 168). Hedberg (1951 cited in Friis *et al.* 2010 p. 113) has documented that an Ericaceous belt occurs on all the high mountains of eastern Africa.

Afromontane shrubland occurs on shallow soils and especially exposed rocky ridges. It is much shorter than Afromontane evergreen bushland and thicket and contains stunted individuals that are dominant in the latter vegetation type. However, Afromontane shrubland also contains species that are usually absent from Afromontane evergreen bushland and thicket (White 1983 p. 168).

Ericaceous vegetation occurs at a few places on the East African coast. Evergreen bushland dominated by *Erica* (synonym: *Philippia*) occurs on waterlogged sites of former lagoons or lake basins (White 1983 p. 188). Interestingly, *Syzygium cordatum* is an associate that is listed both for Ericaceous vegetation on Mafia and Pemba islands (White 1983 p. 189) and for tall “elfin” thickets (3 - 7 m) that occur on peaks in the Uluguru mountains (White 1983 p. 168). We did not include coastal Ericaceous vegetation types into the “montane Ericaceous belt” as coastal vegetation is clearly not associated with mountains.

Figure 27.1. Ericaceous belt with *Erica arborea* forming woodland. The floor is completely covered by ferns, mosses and grasses. Bale Mountains (Ethiopia). Approximate altitude 3600 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 29A. 2010.



Figure 27.2. Ericaceous belt with *Erica arborea* forming woodland. This location has more grass than the location shown in Fig EA. Bale Mountains (Ethiopia). Approximate altitude 3300 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 29C. 2010.



Figure 27.3. Ericaceous belt with burnt vegetation. Numerous shoots (green) appear from the burnt stumps of *Erica arborea*. In between the *Erica arborea* stumps and in the foreground, the subshrub *Alchemilla haumannii* (greyish-green) can be seen. Bale Mountains (Ethiopia). Approximate altitude 3800 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 29B. 2010.







Left: Figure 27.4. The montane Ericaceous belt on Mt. Kahuzi (Kahuzi-Biega-National Park, D.R.Congo. Photograph by E. Fischer (October 1991).

Right: Figure 27.5. *Vaccinium stanleyi*, one of the Ericaceae species of the Ericaceous belt in Rwanda. (Mt. Kahuzi, Kahuzi-Biega-National Park, D.R.Congo). Photograph by E. Fischer (October 1991).



Figure 27.6. *Erica kingaensis* subsp. *rugegensis*, one of the Erica species of the Ericaceous belt in Rwanda. Rwasekoko Swamp, Nyungwe National Park. Photograph by E. Fischer (October 1985).

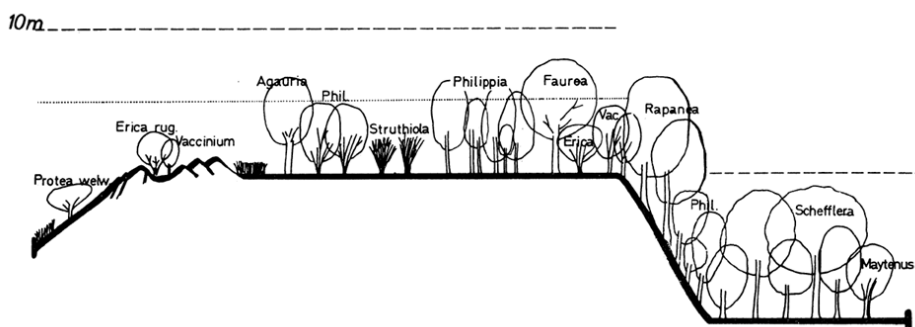


Figure 27.7 Profile diagram of Afromontane Ericaceous bushland ("fruticée sclérophylle à Ericaceae", i.e. sclerophyl scrubland with Ericaceae). This image was the only profile diagram mentioned by White (1983 p. 167) for Afromontane evergreen bushland and thicket. Vegetation similar to the Ericaceous belt occurs on the crests and summits of some smaller mountains as shown below. Lewalle (1972, Fig. 28). Figure obtained from URL <http://www.jstor.org/stable/3667406>



## 27.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 27. Species composition for Montane Ericaceous belt (easily identifiable type, E)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	Uganda
<i>Adenocarpus mannii</i>		x	x	f	f	C	f
<i>Agauria salicifolia</i>	Ericaceae	f	C	f	C	f	f
<i>Berberis holstii</i>		x	x	f		f	f
<i>Clematis simensis</i>		x	x		f	f	f
<i>Discopodium eremanthum</i>		x	x			f	f
<i>Dombeya torrida</i>		x	x	f	f	f	f
<i>Erica arborea</i>	Ericaceae	C	C		f	C	x
<i>Erica benguelensis</i>	Ericaceae		f	C	f	f	C
<i>Erica johnstoniana</i>	Ericaceae			f			C
<i>Erica johnstonii</i>	Ericaceae				f		x
<i>Erica kingaensis</i>	Ericaceae				f	f	x
<i>Erica milanjiana</i>	Ericaceae			x			
<i>Erica rossii</i>	Ericaceae		C			C	
<i>Erica trimera</i>	Ericaceae	C	C			f	C
<i>Erica whyteana</i>	Ericaceae		f	x		f	
<i>Faurea saligna</i>			x	f	f	f	x
<i>Gnidia glauca</i>		x	x	f		f	f
<i>Hagenia abyssinica</i>		x	x	f	f	f	f
<i>Hypericum revolutum</i>		C	x	f	f	f	x
<i>Morella salicifolia</i>		x					
<i>Rapanea melanophloeos</i>		C	x	f	f	f	f
<i>Rhus glutinosa</i>		x					

## 28. Termitaria vegetation (easily identifiable and edaphic type, including bush groups around termitaria within grassy drainage zones, T)

### 28.1. Description

Termite mounds that are more than a metre in diameter are usually covered with dense thickets, unless they have been newly built or are in the final stages of erosion. The species composition of these thickets is completely different from that on the surrounding soil. This pattern is particularly true for the Zambezian region where the flora of termite-mound thickets is extremely high (with more than 700 woody species occurring in this habitat in Zambia alone; White 1983 p. 98).

In the Zambezian region, the flat valley bottoms of larger rivers are usually flooded annually or at least seasonally waterlogged. Where the flood water is shallow, “bush-group” grassland often occurs extensively; this is a mosaic of pure grassland and termite-mound thicket (White 1983 p. 100). A similar pattern occurs in the Zanzibar-Inhambane region where dense thickets occur in seasonally-waterlogged grasslands in parts of the coastal plain (White 1983 p. 189). This vegetation type could potentially be described as “wooded grassland”, but treating it as a patchwork or mosaic of pure edaphic grassland and sharply defined islands of thickets that occur on the better drained soils of old eroded termite mounds gives a better description of this vegetation type.

From the widespread species that White (1983) listed, the following species were encountered in the Zambian national reference: ***Carissa spinarum***, ***Diospyros lycioides***, ***Euphorbia candelabrum***, ***Flueggea virosa***, ***Peltophorum africanum***, ***Rhoicissus tridentata***, ***Steganotaenia araliacea*** and ***Strychnos potatorum*** (White 1983 p. 98).

Figure 28.1. Lateral view of a large example of mopane *termitaria* vegetation. The large trees are mopane (roughly 25 m). Photograph by C. Dudley.



Figure 28.2. *Termitaria* vegetation in Kafue National Park (Zambia). The sides with a south-western exposure carry trees, whereas the sides with a north-eastern exposure carry only grassland. Cole (1963, Fig. 9). Image obtained from URL: <http://www.jstor.org/stable/1794828>.





Figure 28.3. Mopane termitaria vegetation result in a distinct pattern on aerial photographs. Each patch of Mopane termitaria vegetation is between 10 and 20 m in diameter. Photograph by C. Dudley.

## 28.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).



Table 28. Species composition for Termitaria vegetation (easily identifiable and edaphic type, including bush groups around termitaria within grassy drainage zones, T)

SPECIES	Regional status	Malawi	Zambia	Coast
<i>Colophospermum mopane</i>	dominant species of Mopane woodland	C	C	
<i>Abutilon angulatum</i>		f	x	
<i>Acacia gerrardii</i>			x	f
<i>Acacia nigrescens</i>		x	C	
<i>Acacia nilotica</i>			x	f
<i>Albizia amara</i>			C	
<i>Albizia anthelmintica</i>		x	x	f
<i>Allophylus africanus</i>		x	x	
<i>Antidesma venosum</i>			x	f
<i>Apodytes dimidiata</i>			C	f
<i>Balanites aegyptiaca</i>			x	
<i>Bauhinia petersiana</i>			x	
<i>Berchemia discolor</i>		f	x	f
<i>Boscia angustifolia</i>			C	f
<i>Boscia salicifolia</i>			x	f
<i>Capparis tomentosa</i>		f	x	f
<i>Carissa spinarum</i>	widespread species in Zambezan termite-mound thicket		x	f
<i>Cassia abbreviata</i>		x	x	f
<i>Combretum imberbe</i>			C	f
<i>Combretum molle</i>			C	f
<i>Commiphora africana</i>			x	
<i>Dalbergia melanoxylon</i>		x	x	f
<i>Dichrostachys cinerea</i>			x	f
<i>Diospyros bussei</i>	emergent trees overtopping thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region			C
<i>Diospyros consolatae</i>	thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region			C
<i>Diospyros lycioides</i>	widespread species in Zambezan termite-mound thicket		x	
<i>Diospyros mespiliformis</i>		f	C	f
<i>Dobera glabra</i>	emergent trees overtopping thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region		x	C
<i>Dombeya kirkii</i>		f	x	
<i>Dombeya rotundifolia</i>			x	
<i>Entandrophragma caudatum</i>			x	
<i>Erythrina abyssinica</i>			C	f
<i>Erythrophleum suaveolens</i>			C	f
<i>Euclea divinorum</i>			x	f
<i>Euclea natalensis</i>	thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region; characteristic genus in Zambezan termitaria		x	C
<i>Euclea racemosa</i>			x	f
<i>Euphorbia candelabrum</i>	widespread species in Zambezan termite-mound thicket		C	f
<i>Ficus sycomorus</i>			x	f
<i>Flacourtia indica</i>			x	f
<i>Flueggea virosa</i>	widespread species in Zambezan termite-mound thicket		x	f
<i>Garcinia livingstonei</i>			C	f
<i>Grewia bicolor</i>		x	x	
<i>Kigelia africana</i>		f	x	f
<i>Kirkia acuminata</i>		f	C	
<i>Landolphia kirkii</i>			x	f
<i>Lannea discolor</i>			x	
<i>Lannea schweinfurthii</i>		x	C	f
<i>Lonchocarpus capassa</i>		f	x	f
<i>Manilkara mochisia</i>	emergent trees overtopping thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region	x	C	C
<i>Margaritaria discoidea</i>			x	f
<i>Markhamia obtusifolia</i>			x	f
<i>Markhamia zanzibarica</i>		x	C	f
<i>Maytenus senegalensis</i>			x	f
<i>Olea europaea</i>	( <i>Olea europaea</i> ssp. <i>cuspidata</i> , synonym: <i>Olea africana</i> )		x	f
<i>Oncoba spinosa</i>			x	
<i>Oxytenanthera abyssinica</i>	(lowland bamboo species indigenous to Africa)		x	
<i>Parinari curatellifolia</i>			C	f
<i>Peltophorum africanum</i>	widespread species in Zambezan termite-mound thicket		C	f
<i>Phoenix reclinata</i>	(palm species)		x	f

SPECIES	Regional status	Malawi	Zambia	Coast
<i>Phytolacca dodecandra</i>			x	
<i>Piliostigma thonningii</i>			x	f
<i>Psydrax parviflora</i>			x	
<i>Pterocarpus angolensis</i>			x	f
<i>Rhoicissus tridentata</i>	widespread species in Zambezian termite-mound thicket		x	f
<i>Rhus tenuinervis</i>			x	
<i>Schinziophyton rautanenii</i>			x	
<i>Senna singueana</i>			x	f
<i>Sideroxylon inerme</i>	thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region		x	C
<i>Steganotaenia araliacea</i>	widespread species in Zambezian termite-mound thicket		x	
<i>Sterculia africana</i>			C	f
<i>Sterculia quinqueloba</i>		x	x	f
<i>Strychnos lucens</i>			x	
<i>Strychnos potatorum</i>	widespread species in Zambezian termite-mound thicket		C	
<i>Syzygium cordatum</i>			C	f
<i>Syzygium guineense</i>			C	f
<i>Tamarindus indica</i>	emergent trees overtopping thickets on termite mounds in seasonally-waterlogged grassland in the Zanzibar-Inhambane region	x	x	C
<i>Thespesia garckeana</i>			C	
<i>Uapaca kirkiana</i>			x	
<i>Uapaca nitida</i>			x	f
<i>Uapaca sansibarica</i>			x	f
<i>Vitex doniana</i>			x	f
<i>Ximenia americana</i>			x	f
<i>Zanthoxylum chalybeum</i>			x	f
<i>Ziziphus mucronata</i>		x	C	f

## 29. Itigi thicket (edaphic vegetation type, bi)

### 29.1. Description

Itigi thickets are dense deciduous thickets that occur on specialized soils in various drier parts and towards the periphery of the Zambezian floristic region. Itigi thicket took its name from the Tanzanian village of Itigi (5° 42' S, 34° 29' E) where the most extensive manifestation of this vegetation type occurs (White 1983 p. 97).

The soil under Itigi thicket is sandy and varies in depth from 0.6 m to 3 m. It is less stony than many soils under miombo woodland<sup>(22)</sup> (Wm) and thereby favours the intensive root systems of thicket species. During the rainy season, the soil is well aerated, well supplied with water and soft. The soil dries out during the rainy season (at least in its upper layers) and then hardens considerably. (White 1983 p. 97). For these reasons, Itigi thicket is a vegetation type that is edaphically determined (White 1983 p. 49). Itigi thicket can only regenerate in gaps during periods of high rainfall (C. Ruffo, pers. comm.).

Itigi has a discontinuous distribution in the Zambezian region and occurs in Tanzania (central province), Zambia (in the depressions between Lake Mweru and the southern end of Lake Tanganyika) and a few localities in the Democratic Republic of Congo. Related communities occur in Zambia (“Pemba thicket”, see below) and Zimbabwe (White 1983 p. 97).

In Tanzania, Itigi thicket is composed almost entirely of a 3 to 5 m canopy of shrubs that are deciduous for about four months each year. The shrubs have many branches that are interlaced overhead to form a thick continuous cover. The canopy is so dense that light is excluded and a ground layer is virtually absent. Itigi thicket is thornless and climbers are insignificant. It is sharply demarcated from the surrounding miombo woodland (Wm) as there is no transition zone to miombo woodland, although *Brachystegia* trees near the thicket are often stunted. The principal canopy species are ***Baphia burttii***, ***Baphia massaiensis*** (this is also a characteristic species for the ‘mutemwa’ shrub layer of *Baikiaea plurijuga* Zambezian dry deciduous forest and scrub forest [Fn]), ***Burtia prunoides***, ***Combretum celastroides*** (this is also a characteristic species for the ‘mutemwa’ shrub layer of *Baikiaea plurijuga* Zambezian dry deciduous forest and scrub forest [Fn] and a characteristic smaller tree species of Chipya woodland [Wy]), ***Grewia burttii***, ***Pseudoprosopis fischeri*** and ***Tapiphyllum obtusifolium***. Emergent species include ***Albizia petersiana*** (8 m), ***Bussea massaiensis*** (smaller) and ***Craibia brevicaudata*** (slightly taller). ***Euphorbia bilocularis*** is a large candelabra euphorbia that only occurs on termite mounds (White 1983 p. 97)).

22: The statement that soils under Itigi thicket are less stony than many soils under miombo woodland is not necessarily true (J. Timberlake, personal communication).

White (1983) describes the “Pemba thicket” of Zambia as a thicket vegetation type that occurs under similar edaphic circumstances as Itigi thicket. Similar to Itigi thicket, it is named after a village (16 32' S, 27 22' E). Pemba

thicket is normally 6 to 7 m tall and almost impenetrable (except locally as a result of local fires or activities from wild pigs and buffaloes). Most thicket species are deciduous, but few species are evergreen. The most abundant thicket species that White (1983) listed include ***Acalypha chirindica*** (also a characteristic species for the ‘mutemwa’ shrub layer of *Baikiaea plurijuga* Zambezian dry deciduous forest and scrub forest [Fn]), ***Canthium burtii***, ***Combretum celastroides*** (also characteristic in Tanzania and also a characteristic species for the ‘mutemwa’ shrub layer of *Baikiaea plurijuga* Zambezian dry deciduous forest and scrub forest [Fn] and a characteristic smaller tree species of Chipya woodland [Wy]), ***Haplocoelum foliolosum*** (also a characteristic species for Zambezian rupicolous bushland and thicket), ***Rytigynia umbellulata*** and ***Tarenna neurophylla*** (also a characteristic species for Zambezian rupicolous bushland and thicket).

Several emergent trees are heliophilous (‘sun-loving’) species that are unable to regenerate in the shade of the Pemba thicket, including ***Brachystegia spiciformis*** (miombo dominant [Wm]) *Combretum collinum* (also characteristic for Undifferentiated bushland [Wn] and Chipya woodland [Wy]), ***Pericopsis angolensis*** (also characteristic for miombo woodland [Wm] and other Zambezian woodland types) and ***Pterocarpus angolensis*** (also characteristic for miombo woodland [Wm] and other Zambezian woodland types). ***Margaritaria discoidea*** (also a characteristic species for Afromontane dry transitional forest [Fh]), ***Pteleopsis anisoptera*** and ***Strychnos potatorum*** (also a characteristic species of tall scrub forest [fs] that originally occurred in the Ruzizi valley of Burundi and Rwanda) are expected to be able to regenerate within Itigi thicket, but they rarely emerge far above the canopy.

## 29.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).



Figure 29.1. An elephant path within the Itigi thicket (Tanzania). Burt et al. 1942. Photograph 43.  
Figure obtained from URL: <http://www.jstor.org/stable/2256690>.



Figure 29.2. An open sandy strip separates Itigi thicket (right) from Miombo woodland dominated by *Brachystegia spiciformis* (Wm, left). Burt et al. 1942 Photograph 39.  
Figure obtained from URL: <http://www.jstor.org/stable/2256690>.



Figure 29.3. Itigi thicket seen from the central railway during colonial times (Tanzania). Burt et al. 1942 Photograph 40. Figure obtained from URL: <http://www.jstor.org/stable/2256690>.



Table 29. Species composition of Itigi thicket (edaphic vegetation type, bi)

SPECIES	Regional status	Tanzania	Zambia	Zambia (Pemba thicket)
<i>Acalypha chirindica</i>	indicator species	f	x	x
<i>Albizia petersiana</i>	indicator species	C		
<i>Baphia burttii</i>	indicator species	C		
<i>Baphia massaiensis</i>	indicator species	C	C	
<i>Brachystegia spiciformis</i>	indicator species			x
<i>Burttia prunoides</i>	indicator species	C	C	
<i>Bussea massaiensis</i>	indicator species	C	C	
<i>Canthium burttii</i>	indicator species		C	C
<i>Combretum celastroides</i>	indicator species	C	C	C
<i>Combretum collinum</i>	indicator species	f	x	x
<i>Craibia brevicaudata</i>	indicator species	C	f	
<i>Euphorbia bilocularis</i>	indicator species	C		
<i>Grewia burttii</i>	indicator species	C		
<i>Haplocoelum foliolosum</i>	indicator species	f	x	x
<i>Lannea discolor</i>	indicator species			x
<i>Margaritaria discoidea</i>	indicator species	f	x	C
<i>Parinari curatellifolia</i>	indicator species			x
<i>Pericopsis angolensis</i>	indicator species	f	x	x
<i>Pseudoprosopis fischeri</i>	indicator species	C	x	
<i>Pteleopsis anisoptera</i>	indicator species	f	C	C
<i>Pterocarpus angolensis</i>	indicator species	f	x	x
<i>Pterocarpus rotundifolius</i>	indicator species			x
<i>Rytigynia umbellulata</i>	indicator species	f	x	C
<i>Tapiphyllum obtusifolium</i>	indicator species	C		
<i>Peltophorum africanum</i>	characteristic species			x
<i>Strychnos potatorum</i>	characteristic species			C
<i>Tarenna neurophylla</i>	characteristic species	f	C	x
<i>Acacia polyacantha</i>		f	x	
<i>Azelia quanzensis</i>		f	x	
<i>Albizia antunesiana</i>		f	x	
<i>Boscia angustifolia</i>		f	C	
<i>Burkea africana</i>		f	x	
<i>Cassia abbreviata</i>		f	C	
<i>Cassipourea malosana</i>		f	C	
<i>Combretum adenogonium</i>		f	x	
<i>Combretum zeyheri</i>		f	C	
<i>Commiphora africana</i>		f	C	
<i>Diospyros abyssinica</i>		f	C	
<i>Diplorhynchus condylocarpon</i>			x	
<i>Erythrophleum africanum</i>		f	x	
<i>Euphorbia candelabrum</i>		f	C	
<i>Landolphia kirkii</i>		f	x	
<i>Lannea humilis</i>		f	x	
<i>Pseudolachnostylis maprouneifolia</i>		f	C	
<i>Sclerocarya birrea</i>		f	x	
<i>Terminalia mollis</i>		f	x	
<i>Terminalia sericea</i>		f	x	
<i>Vangueria infausta</i>		f	x	
<i>Vitex mombassae</i>		f	x	
<i>Ximenia americana</i>		f	x	
<i>Zanthoxylum chalybeum</i>		f	x	

## 30. Afroalpine vegetation (A)

### 30.1. Description

The vegetation of the highest mountains of tropical Africa ( $\geq 3800$ , including the Aberdares [Kenya], Mt. Elgon [Kenya and Uganda], Mt. Kenya, Mt. Kilimanjaro [Tanzania], Mt. Meru [Tanzania], the Ruwenzori Mts. [Uganda and DRC], the Virunga Mts. [Rwanda and DRC] and the higher peaks of Ethiopia [but see section 3.2]) are characterized by the occurrence of Giant *Senecio* species (up to 6 m; *Senecio* subgenus *Dendrosenecio*), Giant *Lobelia* species (up to 6 m), shrubby *Alchemilla* species and other plants of remarkable lifeforms. Since most of the species also occur in the montane Ericaceous (E, see Volume 3) and Afromontane forest belts (Fa, Fb and Fd, see Volume 2), Afroalpine vegetation can be regarded as an archipelago-like floristic region of extreme floristic impoverishment (White 1983 p. 169).

Afroalpine vegetation occurs on high mountains where night frosts are liable to occur throughout the year (White 1983 p. 46).

Knox and Palmer (1993, Fig 3) provide the following distribution pattern of the 11 species of giant *Senecio* species<sup>(23)</sup>:

- *Senecio* subgenus *Dendrosenecio* *adnivalis*: Ruwenzori Mts.
- *Senecio* subgenus *Dendrosenecio* *battiscombei*: Aberdares and Mt. Kenya
- *Senecio* subgenus *Dendrosenecio* *brassiciformis*: Aberdares
- *Senecio* subgenus *Dendrosenecio* *cheranganiensis*: Cherangani Hills
- *Senecio* subgenus *Dendrosenecio* *elgonensis*: Mt. Elgon
- *Senecio* subgenus *Dendrosenecio* *erici-rosenii*: Ruwenzori, Virunga and Mitumba Mts.
- *Senecio* subgenus *Dendrosenecio* *johnstonii*: Mt. Kilimanjaro
- *Senecio* subgenus *Dendrosenecio* *keniensis*: Mt. Kenya
- *Senecio* subgenus *Dendrosenecio* *keniodendron*: Aberdares and Mt. Kenya
- *Senecio* subgenus *Dendrosenecio* *kilimanjari*: Mt. Kilimanjaro
- *Senecio* subgenus *Dendrosenecio* *meruensis*: Mt. Meru

23: Based on analysis of chloroplast DNA, these authors suggest that the *Dendrosenecio* subgenus originated on Mt. Kilimanjaro





Figure 30.1. Afroalpine vegetation in the foreground with rosettes of *Lobelia rhynchopetalum* (before flowering). In the background the montane Ericaceous belt (see Volume 2) on the slope of the valley with *Erica arborea*. Semien mountains (Ethiopia). Photograph by I. Friis and Sebsebe Demissew (October 2009). Reproduced from *Biologiske Skrifter* of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 30A. 2010.



Figure 30.2. Mosaic of grass sward and *Helichrysum crispinum* heath together with flowering and sterile individuals of *Lobelia rhynchopetalum*. Bale mountains (Ethiopia). Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from *Biologiske Skrifter* of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 30C. 2010.



Figure 30.3. Afroalpine vegetation in the Ruwenzori Mts (Uganda). Photograph by M. Namaganda (June 2008).



Figure 30.4. Afroalpine vegetation in the Ruwenzori Mts (Uganda). Photograph by M. Namaganda (June 2008).



Figure 30.5. Afroalpine vegetation on the Karisimbi Volcano (Rwandan side of the Virunga Mts.). Photograph by E. Fischer (October 1991).



Figure 30.6. Typical East African bird species that occur in Afroalpine vegetation within their natural habitat. Shell guide to East African birds (1960; reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).



## 30.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 30. Species composition for Afroalpine vegetation (A)

SPECIES	Regional status	Ethiopia	Kenya	Rwanda	Tanzania	Uganda
<i>Alchemilla argyrophylla</i>	characteristic (genus)		x		f	x
<i>Alchemilla elgonensis</i>	characteristic (genus)		x			f
<i>Alchemilla johnstonii</i>	characteristic (genus)		x	x	f	x
<i>Lobelia deckenii</i>	characteristic (genus)					C
<i>Lobelia rhynchopetalum</i>	characteristic (genus)	C				
<i>Lobelia stuhlmannii</i>	characteristic (genus)			C		
<i>Lobelia telekii</i>	characteristic (genus)		C			C
<i>Lobelia wollastonii</i>	characteristic (genus)			C		C
<i>Senecio myriocephalus</i>	characteristic (genus)	x				
<i>Senecio subgenus Dendrosenecio adnivalis</i>	characteristic (genus)					C
<i>Senecio subgenus Dendrosenecio elgonensis</i>	characteristic (genus)		f			C
<i>Senecio subgenus Dendrosenecio johnstonii</i>	characteristic (genus)		C	C		f
<i>Senecio subgenus Dendrosenecio keniodendron</i>	characteristic (genus)		C			
<i>Senecio subgenus Dendrosenecio kilimanjari</i>	characteristic (genus)				C	
<i>Senecio subsessilis</i>	characteristic (genus)		f	C	f	f
<i>Adenocarpus mannii</i>		x	f	x	f	f
<i>Erica arborea</i>		C	x	f	f	f
<i>Helichrysum formosissimum</i>				x		C
<i>Hypericum revolutum</i>		C	f	f	f	f

# 31. Afromontane bamboo (B)

## 31.1. Description

***Sinarundinaria alpina*** (synonym: *Arundinaria alpina*) is one of the four bamboo species (giant grasses with erect woody stems of 2 - 20 m [or even taller] that sometimes form pure and virtually impenetrable communities, and that persist for several years, then flower gregariously and then die back,) that are indigenous to Africa (the other species are *Oxytenanthera abyssinica* [mapped in the VECEA map as “L”, see below], *Oreobambos buchwaldii* [it was recorded within species assemblages for various forest vegetation types] and *Arundinaria tessellata* [current name: *Thamnocalamus tessellatus*; it replaces ***Sinarundinaria alpina*** in South Africa]). ***Sinarundinaria alpina*** occurs on most of high mountains of East Africa (Ethiopia to southern Tanzania), but south of Tanzania it is only known to occur on the North Viphya Plateau (Malawi), Dedza Mt. (Malawi) and Mt. Mulanje (Malawi); White 1983 pp. 55 and 166). The Flora Zambesiaca confirms that *Sinarundinaria alpina* does not occur in Zambia. The species presently does not occur on the North Viphya Plateau (C. Dudley, personal observations).

In East Africa, ***Sinarundinaria alpina*** is mostly found between 2400 and 3000 m, although it ascends on Mt. Kenya to 3500 m and descends in the Uluguru Mts. (Tanzania) to 1630 m. It grows most vigorously on deep volcanic soils and gently slopes where the annual rainfall exceeds 1250 mm. The largest areas are found on the Aberdare Range (Kenya, 65000 ha), the Mau Range (Kenya, 51000 ha) and Mt Kenya (39000 ha; White 1983 p. 166). ***Sinarundinaria alpina*** does not form a belt on Mt. Kilimanjaro, whereas a bamboo belt occurs on the adjacent Mt. Meru (White 1983 p. 167).<sup>(24)</sup>

Hemp (2006) provides the following speculations about the absence of the bamboo zone on Mt. Kilimanjaro:

“Another feature of the forests of Kilimanjaro is the absence of a bamboo zone, which occurs on all other tall mountains in East Africa with a similarly high rainfall. Observations on other East African mountains showed that the occurrence of bamboo is linked to a special type of disturbance: the activity of large herbivores. ***Sinarundinaria alpina*** stands are favoured by elephants and buffaloes. On Kilimanjaro these megaherbivores occur on the northern slopes, where it is too dry for a large bamboo zone to develop. They are excluded from the wet southern slope forests by topography and humans who have cultivated the foothills for at least 2000 years. From studies on Mt Kenya (Vanleeuwe and Lambrechts [1999]) it is known that elephants climb slopes only up to a steepness of about 30 degrees. On the south-western and north-eastern slopes of Kilimanjaro, very deep (up to several 100 m) and very steep (>30 degree) valleys exist, which reach high up into the alpine zone. These deep gorges prevent large herbivores migrating from the northern side of the mountain to the southern. Combined with human occupation of the wetter slopes, this

24: Friis *et al.* 2010 (p. 95) mention that Hedberg only recorded distinct mountain bamboo zones from the Aberdares, Mt. Elgon, Mt. Kenya, Mt. Meru, Ruwenzori Mts., and Virungu Mts.



means that the southern and south-eastern montane forests of Mt Kilimanjaro are no longer accessible for buffaloes and elephants. This interplay of biotic and abiotic factors could explain not only the lack of a bamboo zone on Kilimanjaro but also offers possible explanations for the patterns of diversity and endemism.”

Various tree species occur scattered within the bamboo. These tree species probably became established when bamboo plants died following their gregarious flowering (White 1983 p. 167).



Figure 31.1. Afromontane bamboo (*Sinarundinaria alpina*; synonym: *Arundinaria alpina*) in Kabatwa (Volcanoes National Park, Rwanda). Photograph by V. Minani (October 2009).



Figure 31.2. Afromontane bamboo (*Sinarundinaria alpina*; synonym: *Arundinaria alpina*) on Mt. Elgon, Ugandan side. Photograph by E.Fischer (October 1997).



Figure 31.3. Edge of thicket of Afromontane bamboo (*Sinarundinaria alpina*; synonym: *Arundinaria alpina*) near Masha (Ethiopia). In the national reference for Ethiopia, Afromontane bamboo was not described separately from Afromontane forest types in which Afromontane bamboo occurs; this image was included with images for Afromontane rain forest (Fa). Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 25E. 2010.



Figure 31.4. Edge of thicket of Afromontane bamboo (*Sinarundinaria alpina*; synonym: *Arundinaria alpina*) after mass-flowering near Masha (Ethiopia). In the national reference for Ethiopia, Afromontane bamboo was not described separately from Afromontane forest types in which Afromontane bamboo occurs; this image was included with images for Afromontane rain forest (Fa). Photograph by I. Friis and Sebsebe Demissew (January 2009). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 25F. 2010.



### 31.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 31. Species composition for Afromontane bamboo (B)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	Uganda
<i>Sinarundinaria alpina</i>	dominant	f	D	f	D	D	D
<i>Cornus volkensii</i>	characteristic		C	f	f	C	f
<i>Dombeya torrida</i>	characteristic	f	x	f	f	C	C
<i>Faurea saligna</i>	characteristic		f	f	f	C	x
<i>Hagenia abyssinica</i>	characteristic	f	C	f	f	C	C
<i>Ilex mitis</i>	characteristic	f	f	f	x	C	C
<i>Juniperus procera</i>	characteristic	f	f	f		C	f
<i>Lepidotrichilia volkensii</i>	characteristic	f	C	f	f	C	x
<i>Nuxia congesta</i>	characteristic	f	x	f	f	C	x
<i>Podocarpus latifolius</i>	characteristic		x	f	f	C	C
<i>Prunus africana</i>	characteristic	f	f	f	f	C	f
<i>Rapanea melanophloeos</i>	characteristic	f	x	f	x	C	C
<i>Tabernaemontana stapfiana</i>	characteristic		f	f	f	C	f
<i>Agauria salicifolia</i>		f	x	f	x	f	x
<i>Hypericum revolutum</i>		f	C	f	f	f	x
<i>Peddiea fischeri</i>			x		f	f	x
<i>Rhamnus prinoides</i>		f	x	f	x	f	x
<i>Rubus apetalus</i>		f	x	f	f	f	x
<i>Sambucus ebulus</i>			x			f	f
<i>Schefflera volkensii</i>		f	C			f	f



## 32. Mangrove (M)

### 32.1. Description

Mangrove is dominated by trees that occur on shores that are periodically flooded by sea-water. Mangrove was classified by White (1983) as a major physiognomic type and not as a subtype of forests - especially since near climatic and edaphic limits of mangrove, many mangrove species form communities that physiognomically resemble bushland and thickets but are otherwise very similar to “mangrove forests”. All true mangrove species either have pneumatophores which are exposed at low tide or are viviparous (or nearly so, most African species show both these features). The *Bruguiera*, *Ceriops* and *Rhizophora* mangrove species are viviparous: the embryo develops precociously (‘exceptionally early’) after which the hypocotyl undergoes enormous development. Mangrove species have succulent leaves. Their roots are able to desalinate seawater to a high degree but some salts also accumulate in their tissues (only *Avicennia* species excrete salt from their leaves) (White 1983 pp. 54 - 55 and 261).

The true mangrove species that occur in East Africa include *Avicennia marina*, *Bruguiera gymnorhiza*, *Ceriops tagal*, *Heritiera littoralis*, *Lumnitzera racemosa*, *Rhizophora mucronata*, *Sonneratia alba*, *Xylocarpus granatum* and *Xylocarpus moluccensis*. All these species extend further to the east and most reach the western Pacific Ocean (White 1983 p. 261).



Figure 32.1. Mangrove forest. Tanga region of Tanzania. Photograph by H. N. Moshi (May 2009).



Figure 32.2. Typical East African bird species from mangrove within their natural habitat. Shell guide to East African birds (1960; reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).

### 32.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Tabel 32. Species composition for Mangrove (M)

SPECIES	Regional status	VECEA
<i>Avicennia marina</i>	mangrove in East Africa	x
<i>Bruguiera gymnorhiza</i>	mangrove in East Africa	x
<i>Ceriops tagal</i>	mangrove in East Africa	x
<i>Heritiera littoralis</i>	mangrove in East Africa	x
<i>Lumnitzera racemosa</i>	mangrove in East Africa	x
<i>Rhizophora mucronata</i>	mangrove in East Africa	x
<i>Sonneratia alba</i>	mangrove in East Africa	x
<i>Xylocarpus granatum</i>	mangrove in East Africa	x
<i>Xylocarpus moluccensis</i>	mangrove in East Africa	x



## 33. Fresh-water swamp (X)

### 33.1. Description

Permanent swamps occur in depressions where water permanently floods the surface to a shallow depth (seasonal swamps are usually covered with edaphic grassland [see g]). Most of the shallower lakes outside the Guineo-Congolian floristic region (especially those that are not strongly saline, see halophytic vegetation [Z]) have a wide belt of reed-swamp where the dominant species are usually rooted in the soil and have stems that rise out of the water (inside the Guineo-Congolian region, most swampy areas are covered with swamp forest [fs]). The most abundant reed-swamp species is ***Cyperus papyrus*** (a giant sedge species) but other species can also be dominant such as ***Miscanthus violaceus***, *Phragmites australis* and *Phragmites mauritianus* grasses (White 1983 pp. 55 and 265).

True aquatic species occur in deeper water beyond the reed swamp and are either completely submerged or have floating leaves. A belt of floating grasses (principally *Vossia cuspidata*, *Paspalidium germinatum* and *Panicum repens*, but often invaded by *Cyperus papyrus*) frequently separates the reed-swamp from the aquatic vegetation (White 1983 p. 55).

Towards the landward margin of reed-swamp, often a narrow zone occurs of small trees and shrubs that are adapted to swamp conditions. The principal species are *Aeschynomene elaphroxylon*, *Aeschynomene pfundii*, *Ficus trichopoda* (scattered juveniles of swamp-forest trees), *Ficus verruculosa* (scattered juveniles of swamp-forest trees), *Kotschya africana*, *Mimosa pigra*, *Sesbania sesban* and *Syzygium cordatum* (scattered juveniles of swamp-forest trees; White 1983 p. 266).



Figure 33.1. Freshwater swamp in Morogoro District (Tanzania). Photograph by H. N. Moshi (2010).



Figure 33.2. Freshwater swamp dominated by *Cyperus papyrus* west of Mbale Town (Uganda). Photograph by J. Kalema (November 2010).



Figure 33.3. Freshwater swamp in Rwanda occurring at medium altitudes in that country in Akanyaru. Photograph by C. K. Ruffo (October 2009).





Figure 33.4. Typical East African birds of freshwater swamps and lakes within their natural habitat. Shell guide to East African birds (1960; reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).

## 33.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 33. Species composition for Fresh-water swamp (X)

SPECIES	Regional status	Ethiopia	Kenya	Malawi	Rwanda	Tanzania	Uganda	Zambia
<i>Acacia xanthophloea</i>			x	x		f		
<i>Aeschynomene abyssinica</i>		x	x	f		f	f	f
<i>Aeschynomene cristata</i>		C	x	f		f	f	f
<i>Aeschynomene elaphroxylon</i>	trees on the landward margin of reed-swamp	C	x	x	f	f	f	f
<i>Aeschynomene pfundii</i>	trees on the landward margin of reed-swamp	C	x	x		f		f
<i>Aeschynomene schimperi</i>		C	x	f	f	f	f	f
<i>Ceratophyllum demersum</i>	submerged community in deeper water beyond the reed swamp		f	x		f	f	
<i>Cissampelos mucronata</i>		f	f		f	f	C	
<i>Cyperus latifolius</i>		f			C			
<i>Cyperus papyrus</i>	the main constituent of most of the shallower lakes (except those that are strongly saline) outside the Guineo-Congolian region (where swamp forests are more prominent); also in floating mats		C	x	C	C	C	C
<i>Dissotis rotundifolia</i>	principal associate of papyrus		f			f	C	
<i>Echinochloa pyramidalis</i>	species rooted in <i>Vossia cuspidata</i> mats (grass)		f	x		f	f	
<i>Echinochloa stagnina</i>	species rooted in <i>Vossia cuspidata</i> mats (grass)		f			f	f	C
<i>Eichhornia crassipes</i>	free-floating species, pest introduced from tropical America (the water hyacinth)	f	f	x		f		
<i>Ficus verruculosa</i>	juveniles of swamp-forest trees on the landward margin of reed-swamp		f	f	f	f	x	f
<i>Heterotis canescens</i>	associate of <i>Miscanthus violaceus</i> in shallower lakes in which papyrus is absent						C	
<i>Hibiscus diversifolius</i>	principal associate of papyrus	f	f	x	f	f	f	f
<i>Ipomoea rubens</i>			x	x		f	f	
<i>Kotschyia africana</i>	trees on the landward margin of reed-swamp	f	x	x	f	f	f	f
<i>Leersia hexandra</i>	associate of <i>Miscanthus violaceus</i> in shallower lakes in which papyrus is absent (grass)	f	f	x		f	C	C
<i>Lemna perpusilla</i>	free-floating species		f	x		f	f	
<i>Loudetia phragmitoides</i>	in shallow water on the landward side of papyrus swamp (grass)		f			f	f	
<i>Ludwigia leptocarpa</i>	principal associate of papyrus			x				f
<i>Ludwigia octovalvis</i>	principal associate of papyrus		x	x				f
<i>Ludwigia stolonifera</i>	principal associate of papyrus			x				
<i>Melanthera scandens</i>	principal associate of papyrus		f			f	x	
<i>Mikania capensis</i>	principal associate of papyrus		f		f	f	x	
<i>Miscanthus violaceus</i>	in shallow water on the landward side of papyrus swamp; also forms a distinct zone in shallower water from which papyrus is absent (grass)						C	
<i>Nymphaea lotus</i>	community with floating leaves in deeper water beyond the reed swamp	f	f	x		f	f	
<i>Nymphaea nouchali</i>	community with floating leaves in deeper water beyond the reed swamp		f	x	C	f	f	
<i>Oryza longistaminata</i>	(grass)		f			f	f	C
<i>Pennisetum macrourum</i>	(grass)					f	f	C
<i>Persicaria decipiens</i>		f	f			f	C	
<i>Phoenix reclinata</i>	(palm species)	f	f	x	C	f	f	f
<i>Phragmites mauritianus</i>	common in silted areas and lakes of volcanic origin in East Africa (grass)		x	C		f	f	C
<i>Pistia stratiotes</i>	free-floating species	f		x				
<i>Pycnus mundtii</i>			f	x	C	f	f	
<i>Sesbania bispinosa</i>			x			f		
<i>Sesbania sesban</i>	trees on the landward margin of reed-swamp	C	x	x	f	f	f	f
<i>Syzygium cordatum</i>	juveniles of swamp-forest trees on the landward margin of reed-swamp		f	x	C	f	x	f
<i>Typha domingensis</i>			x	C		f	f	
<i>Typha latifolia</i>	locally replaces papyrus at higher altitudes		x				f	
<i>Utricularia gibba</i>	associate of <i>Miscanthus violaceus</i> in shallower lakes in which papyrus is absent		f	x		f	f	
<i>Vallisneria spiralis</i>	submerged community in deeper water beyond the reed swamp			x				
<i>Vigna luteola</i>	principal associate of papyrus		f	x		f	f	
<i>Voacanga thouarsii</i>			x	x			f	f
<i>Vossia cuspidata</i>	floating mat at the edge of reed-swamps, also pioneer of reed-swamp		f	x		f	f	



## 34. Halophytic vegetation (Z)

### 34.1. Description

Halophytes are a relatively small group of plant species that can grow on saline soils. The most typical halophytes absorb soluble salts (especially Sodium chloride) and tolerate high concentrations in the cell sap of their leaves. The vegetation on saline soils is dominated by halophytes and is physiognomically varied, including halophytic grassland, wooded grassland, shrubland and bushland (White 1983 pp. 55 and 266).

Saline soils are frequently found in arid and semi-arid regions where rainfall is insufficient to transport salts. The distribution of saline soils is also partially determined by geology as they can occur in wetter regions around springs that bring soluble salts to the surface (White 1983 p. 266). The halophytic grass *Drake-brockmania somalensis* occurs near outlets of the major tributary streams to the Chalbi desert (Kenya, this edaphic desert is seasonally flooded, White 1983 p. 120).

In parts of East Africa, salts that are derived from volcanic deposits rich in Sodium are deposited in lake basins and river valleys. As a consequence, halophytic vegetation occurs in most of the lake basins of the Eastern Rift (especially Lakes Bogoria [Kenya], Elementeita [Kenya], Eyasi [Tanzania], Nakuru [Kenya], Magadi, Manyara [Tanzania], Natron [Tanzania], Rukwa [Tanzania] and Turkana [Kenya]). Halophytic vegetation also occurs around Lake Mweru Wantipa (Zambia), a lake that also lies in a down-faulted depression with internal drainage (White 1983 pp. 266 - 267).

The halophytic vegetation in the Lake Rukwa basin (Tanzania) is chiefly grassland and can be subdivided in three zones: (i) the beach zone that marks the maximum extent of the lake has pure stands of 1 to 2 m tall *Sporobolus robustus*; (ii) the alkaline swamp is colonized by *Diplachne fusca* (current name: *Leptochloa fusca*; this grass species also dominates alkaline swamps south of Lake Eyasi [Tanzania]); and (iii) the alkaline flats (areas of the lake bed that are successively flooded or drying up) are colonized first by *Sporobolus spicatus* (a species that is also a chief plant around other lake basins in the Eastern Rift) but are replaced by *Odyssea jaegeri* when the lake shallowly refills (White 1983 p. 267).

Many of the flat valleys in the drier parts of Tanzania have alkaline soils. This is especially the case for the flood plains of the Pangani River as large amounts of salt are released from the volcanic deposits of Mt. Kilimanjaro and Mt. Meru. Prominent halophytes include *Salvadora persica*, *Suaeda monoica*, *Sporobolus robustus* and *Triplocephalum holstii*. Other species occur on the flood plain such as *Acacia xanthophloea* (a species that may not persist if high levels of sodium reach their rooting horizon [White 1983 p. 30]) and *Sesbania sesban* (White 1983 p. 267).



Figure 34.1. Salt pan surrounded by scrub of *Suaeda monoica* (Chenopodiaceae). The surrounding vegetation is desert (D) and semi-desert (S). Between Dichioto (Ethiopia) and the border with Djibouti. Approximate altitude 200 m. Photograph by I. Friis and Sebsebe Demissew (October 2006). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 35B. 2010.



Figure 34.2. Salt pan surrounded by scrub of *Suaeda monoica* (Chenopodiaceae). In the background lava flows without vegetation (desert [D]). Between Dichioto (Ethiopia) and the border with Djibouti. Approximate altitude 200 m. Photograph by I. Friis and Sebsebe Demissew (October 2006). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 35D. 2010.



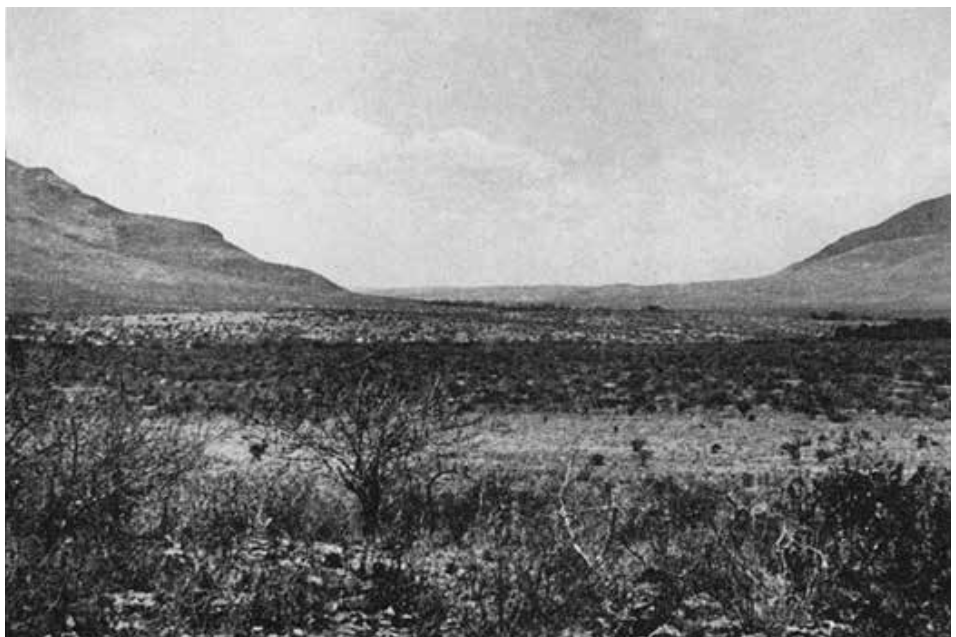
Figure 34.3. A section of the Pangani floodplain not far from Hedaru with halophytic vegetation characterized by *Suaeda monoica*. Altitude approximately 650m. The Pare Mountains can be seen in the background. Photograph taken during the rainy season. Photograph by H. N. Moshi (May 2009).



Figure 34.4. Detail of *Suaeda monoica*. Photograph in same location as previous photograph (Figure 11.3). Photograph by H. N. Moshi (May 2009).



Figure 34.5. The original caption for this photograph was: semi-arid vegetation in the Mkomazi gap between the southern Pare and the west Usambara mountains (Tanzania; photograph by P. J. Greenway). Although this area was mapped by Gillman (1949) as "desert and semi-desert", we mapped it in the VECEA map as halophytic vegetation since we expect that most of these areas typically contain *Suaeda monoica* (salt bush; see also photographs 11.3 and 11.4 from the same general area). Gillman (1949, Fig 17). Image obtained from URL: <http://www.jstor.org/stable/211155>.



## 34.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 34. Species composition for halophytic vegetation (Z)

SPECIES	Regional status	Ethiopia	Kenya	ZIT (Tanzania subtype)	ZaT (Tanzania subtype)	Zambia
<i>Cyperus laevigatus</i>	chief plants around saline lakes in Kenya and Uganda		f	C	f	
<i>Sporobolus spicatus</i>	chief plants around saline lakes in Kenya and Uganda; alkaline flats around Lake Rukwa (grass)		C	C	f	C
<i>Drake-brockmania somalensis</i>	halophytic grass that grows near the outlets at the edge of the Chalbi desert		C			
<i>Leptochloa fusca</i>	alkaline swamp in the Lake Rukwa basin; Wembere depression south of Lake Eyasi (grass)		f	C	f	C
<i>Psilolemma jaegeri</i>	alkaline flats around Lake Rukwa (grass)					C
<i>Salsola africana</i>			C			
<i>Salvadora persica</i>	prominent halophyte in flood plain of the Pangani river	f	f	f	C	f
<i>Sesbania sesban</i>	flood plain of the Pangani river	f	x	f	C	f
<i>Sporobolus robustus</i>	beach zone on fringe of Lake Rukwa; prominent halophyte in the flood plain of the Pangani river (grass)				C	
<i>Suaeda monoica</i>	prominent halophyte in flood plain of the Pangani river; replaces <i>Acacia xanthophloea</i> when the water table rises; also in semi-desert dwarf shrubland	C	C	f	C	
<i>Triplocephalum holstii</i>	prominent halophyte in flood plain of the Pangani river		f	f	C	



## 35. Edaphic grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type, g)

### 35.1. Description

White (1983) did not strictly apply a differentiation between edaphic wooded grassland (with cover percentages of 10 - 40% woody species) and edaphic grassland (with cover percentages of <10% woody species) since both types intergrade and edaphic wooded grasslands are often difficult to delimit from the more open grasslands with which they are associated (White 1983 pp. 50 - 52). Within the VECEA map, we loosely <sup>(25)</sup> defined “edaphic wooded grassland” as “edaphic grassland with scattered woody species” and “edaphic grassland” as “edaphic grassland without scattered woody species”. This means that some vegetation types that would have been classified as “edaphic grasslands” in a strict physiognomic classification system (i.e. woody cover < 10%) may have been allocated to “edaphic wooded grasslands”.

The most widespread edaphic grasslands are those associated with seasonally or permanently waterlogged soils. They are limited in areas with short or no dry seasons (such as the Guineo-Congolian floristic region), but are widespread in regions which experience strongly seasonal rainfall (such as the Indian Ocean coastal belt and the Somalia-Masai, Sudanian and Zambezan floristic regions). Waterlogged soils usually occur in depressions which receive more water than is supplied by incident rainfall, but sometimes parent material has an overriding effect such as on edaphic grasslands that occur on volcanic soils (mapped as a distinct VECEA subtype [gv]; White 1983 p. 51). Alkaline grasslands that occur in basins are considered to be halophytic vegetation (mapped separately in VECEA as Z; White 1983 p. 100).

Although White (1983) described edaphic grasslands and wooded grasslands separately for the various floristic regions, we did not apply a floristic classification system to edaphic grasslands and edaphic wooded grasslands in the VECEA map.

Zambezan edaphic grassland<sup>(26)</sup> is widespread and occurs principally in four habitats: (i) seasonally waterlogged depressions on the Central African Plateau that are covered with edaphic grassland (“dambos”); (ii) flood plains of rivers and basins with internal drainage; (iii) Kalahari Sand of low relief; and (iv) sandy edges of dambos (White 1983 pp. 99 - 101):

Dambo grassland occurs above 1200 m and where there is seasonal flooding (some parts remain boggy throughout the year). The vegetation is usually a medium-dense grass mat of rather uniform appearance and height (50 to 100 cm with flowering culms of 1 to 2 m). *Loudetia simplex* is the most characteristic grass species and is dominant over large areas (White 1983 pp. 99 - 100).

25: among the exceptions that we made to the general rule, we did not include suffrutex grassland among wooded grassland types and neither did we include edaphic grassland on volcanic soils (gv) among wooded grassland types (although scattered *Acacia mellifera* may occur).

26: edaphic grasslands were studied in detail in several places because swarms of red locusts (*Nomadacris septemfasciata*) only originate from certain edaphic grassland areas. Four recognized major outbreak areas of the red locust are the Mweru-wa-Ntipa depression in Zambia and the Rukwa valley, the Malagarasi drainage basin and the Wembere depression in Tanzania (Vesey-Fitzgerald 1963).

Flood-plain grassland occurs in the valleys of larger rivers where erosion has covered the valley floors with alluvium (mostly heavy clay) and where seasonal rainfall results in seasonal waterlogging. These valleys are covered with a complex and constantly changing mosaic of edaphic grassland, permanent swamp vegetation (X) and termite-mound thickets (“bush groups”, see termitary vegetation [T]), which makes it very difficult to impossible to map these types separately. Floodplain grasslands can be subdivided into wetter types and better-drained types. The most extensive areas of flood-plain grasslands of the Zambezi region occur in the Lake Chilwa basin of Malawi, the Malagarasi and Rukwa valleys of Tanzania, the Bangweulu and Mweru Wantipa basins of Zambia and the Chambeshi, Kafue and Upper Zambezi valleys of Zambia (White 1983 p. 100).

*Kalahari suffrutex* grassland is a short wiry grassland that occurs on oligotrophic Kalahari Sand that is seasonally waterlogged. Trees are virtually absent and have been replaced by rhizomatous geoxylic suffrutices that are usually less than 0.6 m tall. At least under the present conditions, their stems are burnt back to ground level every year. The underground parts are usually of massive proportions and greatly exceed the phytomass of grasses, so these communities can be described as “underground forests” although above-ground they look like grasslands most of the year. Most of the suffrutex species are closely related to forest or woodland tree or liana species. The most abundant suffrutex is ***Parinari capensis*** and the most widespread dominant grasses are ***Loudetia simplex*** and ***Monocymbium cerasiiforme*** (White 1983 pp. 100 - 101). Widely distributed suffrutices described by Fanshawe (1971 p. 45) to occur in catenary regression stages of Kalahari woodlands include *Annona stenophylla*, *Chamaeclitandra henriquesiana*, *Diospyros chamaethamnus*, *Diospyros virgata*, *Gardenia brachythamnus*, *Lannea edulis*, *Leptactina benguelensis*, *Napoleonaea gossweileri*, ***Parinari capensis***, *Pygmaeothamnus zeyheri*, *Strobilanthopsis linifolia* and *Strychnos gossweileri*.

Most of the dambos are fringed by a narrow zone of sparse wiry grassland with abundant geoxylic suffrutices that are similar to Kalahari suffrutex grassland (White 1983 pp. 100 - 101). Fanshawe (1971 p. 52) describes suffrutex wooded grassland that occurs within a catenary sequence from Undifferentiated woodland (Wn) to grassland. Common suffrutices include *Annona stenophylla*, *Astripomoea malvacea*, *Brackenridgea arenaria*, *Combretum platypetalum*, *Cryptosepalum maraviense*, *Duosperma crenatum*, *Eriosema englerianum*, *Fadogia homblei*, *Gnidia kraussiana*, *Hibiscus rhodanthus*, *Ipomoea vernalis*, *Lannea edulis*, *Litogyne gariepina*, ***Parinari capensis*** and *Pygmaeothamnus zeyheri*.

Edaphic grassland in the Somalia-Masai floristic region was classified as edaphic wooded grassland, although treeless plains dominated by *Chrysopogon plumulosus* were described to occur in Somalia within deciduous bushland (Bd) and water-receiving depressions with black and cracking clays in Central Tanzania are treeless (but they are separated by an ecotone of wooded grassland, however; see edaphic wooded grassland [we]; White 1983 p. 116). Edaphic grassland that occurs on volcanic soils is mapped and described as a distinct subtype (mapping unit gv; see below).



Figure 35.1. Edaphic grassland in Amboseli National Park (Kenya). Photograph by F. Gachathi (2008).



Figure 35.2. A typical dambo near Mbala (Zambia) with its centre of open grassland and fringe of small trees. In the background, Miombo woodland (Wm) with *Brachystegia microphylla* (a species virtually confined to rocky hills and escarpments, White 1983 p. 93). Burt et al. (1942 p. 79) comment that “a dambo often gives the impression of a wide road through the general monotony of the *Brachystegia* forest” (i.e. miombo woodland [Wm]). Burt et al. (1942, Photograph 7). Image obtained from URL: <http://www.jstor.org/stable/2256690>.



Figure 35.3. The “rain pond catena” in Tanzania was classified by the VECEA project as a catena of Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket (Bdd) / edaphic grassland on drainage-impered or seasonally flooded soils (g). Although the water-receiving depressions are typically treeless grasslands, usually they are separated from deciduous bushland (Bd) by an ecotone of wooded grassland that is dominated by gall *Acacias* (especially *A. drepanolium*, *A. seyal*, *A. malacocephala* and *A. pseudofistula*; White 1983 p. 116; see also Gillman 1949 p. 29). Gillman (1949, Fig 30; this is one of the photographs that was cited by White (1983 p. 116) for Somalia-Masai edaphic grassland).

Edaphic grassland that occurs on volcanic soils is mapped and described as a distinct subtype (mapping unit gv; see below).

Edaphic grassland of the Zanzibar-Inhambane region was described as a edaphic wooded grassland (we) since woody trees occur (although widely scattered; these areas also contain thicket-covered termite mounts [mapping unit T]; White 1983 p. 189).

In most Sudanian edaphic grasslands there is an admixture of woody plants (White 1983 p. 107). Edaphic grasslands were not described by White (1983) for the Afromontane floristic region, although he stated that “there are undoubtedly small areas of edaphic grassland” (White 1983 p. 168). No mention is made of edaphic grasslands for the Lake Victoria regional mosaic.

## 35.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 35. Edaphic grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type, g)

SPECIES	Regional status	Kenya	Malawi	gdT (Tanzania subtype)	gT (Tanzania subtype)	gbU (Uganda subtype)	geU (Uganda subtype)	gsU (Uganda subtype)	Zambia
<i>Acroceras macrum</i>	Zambezian edaphic grassland (wetter types of floodplain grasslands)	f		f	C	f	f	f	x
<i>Andropogon brazzae</i>	Zambezian edaphic grassland (better-drained types of floodplain grasslands)			f	C				
<i>Andropogon schirensis</i>	Zambezian edaphic grassland (dambo grasslands, suffrutex grasslands)	f		C	f	f	f	f	x
<i>Aristida adscensionis</i>	Somalia-Masai edaphic grassland (clays plains in Somalia)	x							
<i>Aristida stipitata</i>	Zambezian edaphic grassland (suffrutex grasslands)								x
<i>Bothriochloa bladhii</i>	(grass)	f	x	f	f	f	f	f	x
<i>Brachiaria brizantha</i>	(grass)	f	x	f	f	f	f	f	x
<i>Brachiaria humidicola</i>	(grass)	f	x	f	f				x
<i>Brachiaria jubata</i>	(grass)					C	f	f	
<i>Chloris gayana</i>	edaphic grasslands of the Serengeti plains	f	x	f	f	f	f	f	x
<i>Cynodon dactylon</i>	Somalia-Masai edaphic grasslands; edaphic grasslands of the Serengeti plains	x	x	f	f	f	f	f	x
<i>Cyperus dives</i>	(sedge)	f		f	f	f	C	f	
<i>Cyperus latifolius</i>	(sedge)					f	C	f	
<i>Cyperus longus</i>	(sedge)	f	C	f	f	f	f	f	
<i>Dichanthium annulatum</i>	(grass)	f	x	f	f				x
<i>Echinochloa haploclada</i>	(grass)	x	f	f	f	f	f	f	x
<i>Echinochloa pyramidalis</i>	Zambezian edaphic grassland (wetter types of floodplain grasslands)	f	x	f	C	f	C	f	x
<i>Echinochloa stagnina</i>	Zambezian edaphic grassland (wetter types of floodplain grasslands)	f		f	C	f	f	f	x
<i>Entolasia imbricata</i>	Zambezian edaphic grassland (better-drained types of floodplain grasslands)	f	x	f	C	f	f	f	x
<i>Eragrostis atroviens</i>	(grass)	f	x	f	f				x
<i>Erianthus teretifolius</i>	Zambezian edaphic grassland (dambo grasslands)			C	f				
<i>Eustachys paspaloides</i>	edaphic grasslands of the Serengeti plains	f		f	f	f	f	f	x
<i>Fimbristylis dichotoma</i>	(sedge)					f	f	C	
<i>Hyparrhenia bracteata</i>	Zambezian edaphic grassland (dambo grasslands)	f	x	C	f	f	f	f	x
<i>Hyparrhenia diplandra</i>	Zambezian edaphic grassland (dambo grasslands)	f		C	f	f	f	f	x
<i>Hyparrhenia filipendula</i>	(grass)	f	x	f	f	C	f	f	x
<i>Hyparrhenia newtonii</i>	Zambezian edaphic grassland (dambo grasslands)			C	f	f	f	f	x
<i>Hyparrhenia nyassae</i>	(grass)	f	x	f	f	f	f	f	x
<i>Hyparrhenia rufa</i>	(grass)	f	x	f	f	f	f	C	x
<i>Imperata cylindrica</i>	(grass)	f	x	f	f	f	f	f	x
<i>Leersia hexandra</i>	Zambezian edaphic grassland (wetter types of floodplain grasslands)	f	x	f	C	f	C	f	x
<i>Loudetia kagerensis</i>	(grass)	f		f	f	f	f	C	
<i>Loudetia simplex</i>	Zambezian edaphic grassland (dambo grasslands, better-drained types of floodplain grasslands, suffrutex grassland)	f	x	C	C	f	f	f	x
<i>Microchloa kunthii</i>	edaphic grasslands of the Serengeti plains	f		f	f	f	f	f	
<i>Monocymbium cerasiiforme</i>	Zambezian edaphic grassland (dambo grasslands, better-drained types of floodplain grasslands, suffrutex grassland)		x	C	C				x



## 36. Edaphic grassland on volcanic soils (edaphic subtype, gv)

### 36.1. Description

The grasslands of the Serengeti Plains grow on soils that are derived from volcanic ash. Outside the greater Serengeti region, grasslands occurring on volcanic ash are very restricted in Africa (White 1983 pp. 125 and 126). Huge quantities of fine whitish-grey ash were produced by eruptions around 150,000 years ago by the now extinct Kerimasi volcano (2° 52' S, 35° 56' E). The ashes fell over a wide area where it resulted in a relatively flat surface over a formerly undulating peneplain. The ash hardened to form grey and light-brown calcareous tuffs and almost continuous layers of calcitic hard-pan layers at successive layers (with the accumulation of lime through downward leaching; White 1983 p. 126).

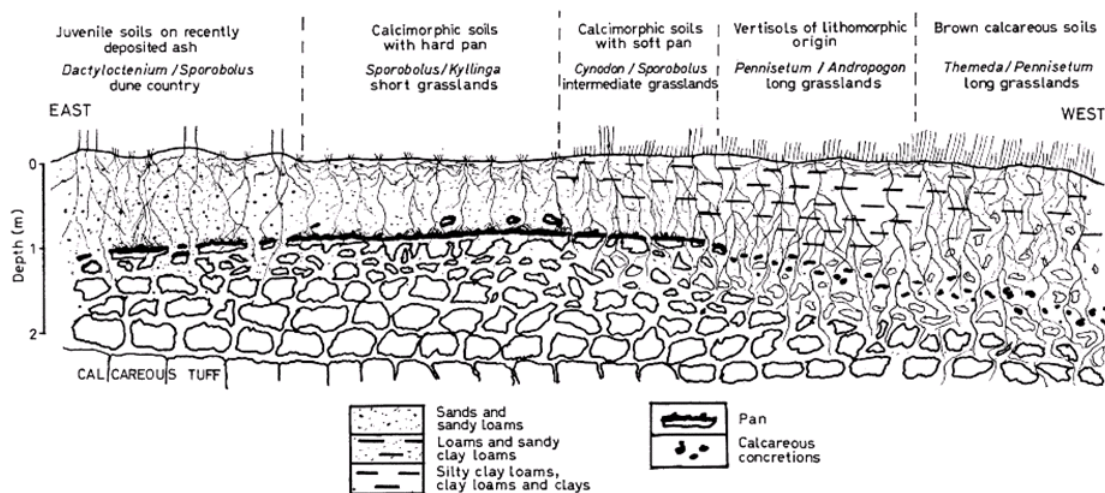


Figure 36.1. Profile diagram of the soil – edaphic grassland associations running east to west across the Serengeti Plains. Surface topography is not drawn to scale. White (1983 p. 126) describes that the gradient from the juvenile ash soils in the east to the more mature brown calcareous soils in the west are paralleled by a climatic gradient as annual rainfall gradually increases from the 380 mm in the east to 780 mm in the west. Anderson and Talbot (1965, Figure 2). Image obtained from URL: <http://www.jstor.org/stable/2257564>



Figure 36.2. Edaphic grassland on volcanic soils along the Namanga – Arusha road (Tanzania). Altitude approximately 1700 m. Photograph by H. N. Moshi (2009).

## 36.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 36. Species composition for Edaphic grassland on volcanic soils (edaphic subtype, gv)

SPECIES	Regional status	gvK (Kenya)	gvT (Tanzania)
<i>Acacia mellifera</i>	scattered bushes that sometimes occur on more stable areas between the dunes on juvenile soils on volcanic ash in the Serengeti plains		x
<i>Andropogon greenwayi</i>	edaphic grasslands of the Serengeti plains		C
<i>Aristida adscensionis</i>	Somalia-Masai edaphic grassland	x	
<i>Aristida mutabilis</i>		x	
<i>Chloris gayana</i>	edaphic grasslands of the Serengeti plains		C
<i>Cynodon dactylon</i>	edaphic grasslands of the Serengeti plains		C
<i>Digitaria macroblephara</i>	edaphic grasslands of the Serengeti plains		C
<i>Enteropogon macrostachyus</i>	(grass)	x	
<i>Eragrostis superba</i>	(grass)	x	
<i>Eragrostis tenuifolia</i>	edaphic grasslands of the Serengeti plains		C
<i>Eustachys paspaloides</i>	edaphic grasslands of the Serengeti plains		C
<i>Heteropogon contortus</i>	(grass)	x	
<i>Indigofera spinosa</i>		x	
<i>Microchloa kunthii</i>	edaphic grasslands of the Serengeti plains		C
<i>Panicum coloratum</i>	edaphic grasslands of the Serengeti plains		C
<i>Pennisetum mezianum</i>	edaphic grasslands of the Serengeti plains		C
<i>Pennisetum stramineum</i>	edaphic grasslands of the Serengeti plains		C
<i>Sporobolus ioclados</i>	edaphic grasslands of the Serengeti plains		C
<i>Sporobolus spicatus</i>		x	
<i>Themeda triandra</i>	edaphic grasslands of the Serengeti plains		C

## 37. Vegetation of sands (edaphic type, s)

### 37.1. Description

This vegetation type was not described in “the vegetation of Africa”.

### 37.2. Species composition

(Please check the methodology and information from Volumes 2 - 5 for more details on how the information on species composition for the different manifestations of this potential natural vegetation type was compiled. In composition tables, "x" indicates that the species is expected to be present, "C" indicates that the species was identified as characteristic species and "f" indicates a species that was not listed in the documentation that we consulted although it is known to occur in the specific country).

Table 37. Species composition for Vegetation of sands (edaphic type, s)

SPECIES	Regional status	sM (Malawi)	sC (Coast)
<i>Cadaba farinosa</i>			x
<i>Flacourtia indica</i>		f	x
<i>Garcinia livingstonei</i>		f	x
<i>Pandanus kirkii</i>			f
<i>Parinari curatellifolia</i>		C	f
<i>Salvadora persica</i>		f	x
<i>Sterculia africana</i>		f	x
<i>Terminalia sericea</i>		C	

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